DEPARTMENT OF DEFENSE
DEFENSE OFFICE OF PREPUBLICATION AND SECURITY REVIEW
1155 DEFENSE PENTAGON
WASHINGTON, DC 20301-1155

September 6, 2017
Ref: 17-S-0324

Ms. Linda Barron
RAND Corporation
1200 South Hayes Street
Arlington, VA 22202-5050

Dear Ms. Barron:

This is in response to your November 17, 2016, correspondence (copy enclosed) requesting public release approval of the RAND publication entitled:

- *U.S. Military Capabilities and Forces for a Dangerous World*

The RAND publication is **Cleared as Amended** for public release. The amendments are clearly identified with black boxes around the text to be removed and red text boxes in the margins. Required national security amendments are located on pages: xiv, 7, 12, 13, 30, 31, 32, 54, 57, 63, 64, 88, 90, 108, 111, 135, 139, 140, 144, 162, 163 and 164.

This approval does not include any photograph, picture, exhibit, caption, or other supplemental material not specifically approved by this office, nor does this approval imply Department of Defense endorsement or factual accuracy of the material.

You have the right to administratively appeal this response by submitting through this office to the appellate authority: Director of Administration, Office of the Deputy Chief Management Officer. The appeal must offer written justification to support reversal of each required amendment being appealed. Send the appeal postmarked within 60 days from the date of this response to the following address:

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18-L-0334/DOPSR/0001

Enclosed are copies of the cleared as amended title page and the pages with the required amendments. Please direct any questions regarding this case to Mr. Daniel Chykirda, Security Review Specialist, at 703-697-6763 or by email at daniel.j.chykirda.civ@mail.mil.

Sincerely,

Carmen R.G. Moore

for Darrell W. Walker
Chief

Enclosures:
As stated

18-L-0334/DOPSR/0002

RAND CORPORATION

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November 17, 2016

Mr. Mark Langerman, Chief
Office of Security Review
Department of Defense
1155 Defense Pentagon
Room 2A 534
Washington, DC 20301

Dear Mr. Langerman,

Enclosed are three pre-edit (disregard editorial or formatting issues) copies of the following RAND publication, RR-1782-IRD, ***U.S. Military Capabilities and Forces for a Dangerous World***, by David A. Ochmanek, Peter A. Wilson, Brenna Allen, John Speed Meyers, and Carter C. Price.

RAND believes this report to be suitable for unlimited distribution and is sending this document to you for an open publication review by your office.

Thank you for your assistance, and please do not hesitate to contact me if you have any questions or need additional information. I can be reached at (703) 413-1100, x5135.

Sincerely,

Linda Barron

Linda Barron
Enclosure: RR-1782-IRD (3 copies)

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Research Report

U.S. Military Capabilities and Forces for a Dangerous World

Rethinking the U.S. Approach to Force Planning

David A. Ochmanek, Peter A. Wilson, Brenna Allen, John Speed Meyers, and Carter C. Price

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Department of Defense
OFFICE OF PREPUBLICATION AND SECURITY REVIEW

RAND National Security Research Division

RR-1782-IRD
October 2016
Prepared for RAND Corporation

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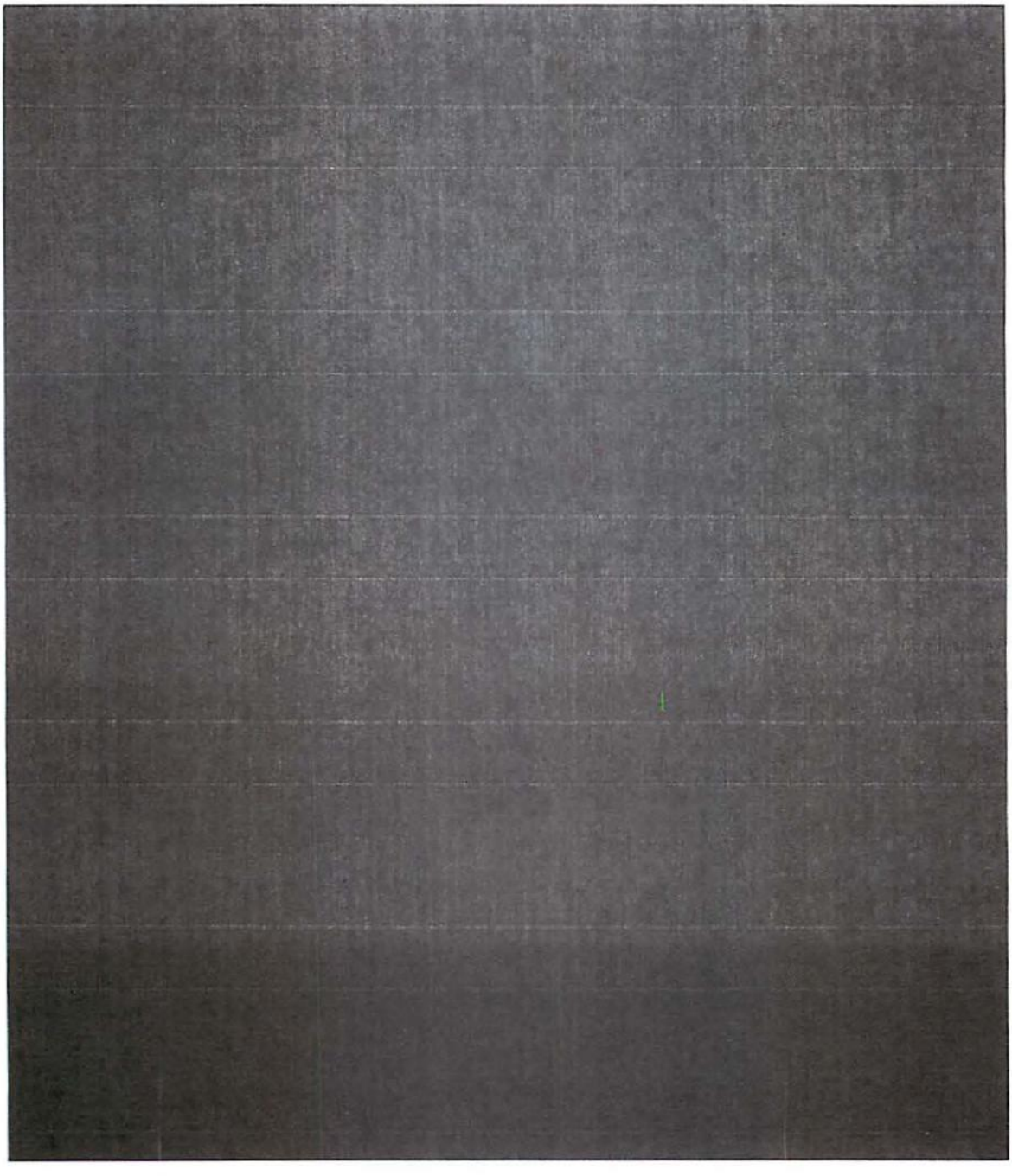
Table S.2: Priority Enhancements to U.S. Forces and Posture



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2. China: Ensuring Access to the Air and Sea Commons and Sustaining Capabilities for Effective Power Projection Operations

Background and Purpose

Recognizing that "important U.S. economic and security interests are inextricably linked to developments in . . . the Western Pacific and East Asia," the Obama Administration announced in 2011 a major foreign and security policy initiative to "rebalance" toward the Asia-Pacific region.[9] By shifting U.S. attention and resources toward the region, the rebalance initiative is intended to strengthen security and stability and to help ensure that the United States remains an important factor in regional affairs. This initiative has directly affected U.S. defense planning. A prominent theme in the Administration's rollout of the rebalance was a determination to "modernize" and enhance the U.S. military posture in the region and to increase efforts aimed at ensuring that U.S. forces will be able to effectively project power into the region well into the future.

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e United States has taken steps to strengthen and adapt its security ties with treaty allies South Korea, Australia, and the Philippines, and is exploring new avenues for security cooperation with India. Washington has also worked to expand its military-to-military ties with Singapore, Indonesia, and more recently Vietnam.[10] These efforts have yielded a growing [redacted] Given the enduring importance of the region and the breadth of challenges posed by China's growing power and aspirations, there is little doubt that future administrations will seek the same general objective.

This chapter charts the trends in Chinese defense policies, activities, and defense capabilities and how they intersect with U.S. interests. It also describes a plausible scenario that highlights the use of Chinese forces against a U.S. ally as a way of defining what capabilities the United States might have to face. It concludes with a discussion of what conflict with China might imply for force planning.

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[9] See *Sustaining U.S. Global Leadership: Priorities for 21st Century Defense*, Washington, D.C.: U.S. Department of Defense, January 2012, p. 2. See also Barack Obama, "Remarks by President Obama to the Australian Parliament," Washington, D.C.: The White House, November 17, 2011.

[10] For an summary of the Australian Government's view of these trends and its twenty year response see *2016 Defence White Paper*, Canberra: Australian Government, Department of Defence, Commonwealth of Australia, 2016 and a critical view of this white paper see Hugh White, "It's Time We Talked About War With China", Lowy Institute, March 4, 2016

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have also begun fielding a new generation of AWACS aircraft.[23] Equipped with modern air-to-air missiles and backed by robust networks for command and control, Russian and Chinese fighters today present a far more formidable challenge to air superiority than any adversary the United States has faced since the Cold War.

To date, neither Russia nor China has fielded an operational fifth-generation fighter similar to the U.S. F-22 or F-35. In a direct engagement, assuming aircrews with comparable skills, fifth-generation fighters would be expected to achieve highly favorable exchange ratios against their fourth-generation foes such as the Chinese variant of the Sukhoi fighter bomber, the J-11. But only a small portion of the U.S. fighter force to date has been equipped with fifth-generation aircraft, and China is building its own advanced fighters with low-observable features. Moreover, Chinese commanders would strive to limit the flow of U.S. combat aircraft into the theater and into the fight by launching heavy attacks on U.S. forward operating bases. It is therefore likely that, in a future conflict involving China, U.S. and allied air forces would have As Amended: Remove bered, at least in the conflict's early phases.[24] These developments will make it much more costly for the United States and its allies to gain the air superiority to which they have grown accustomed [redacted]

Enhanced Naval Power Projection. The PLAN has made major strides in modernizing its surface and sub-surface fleets. As one benchmark of the pace of this modernization, China in 2013 and 2014 launched more naval ships than any other country.[26] As a result of these investments, China's surface fleet features growing numbers of destroyers and frigates with modern combat management systems and sensors as well as long-range surface-to-air and surface-to-surface missiles. Similarly, the PLAN is modernizing its submarine fleet with growing numbers of nuclear-powered vessels and more capable anti-ship cruise missiles. Further, PLAN seems to have embarked upon a long-term effort to develop and deploy several aircraft carriers. After a long period of neglect, the PLAN's amphibious fleet is being expanded and modernized as well.[27]

The Struggle for Information Superiority. Adversaries that have studied U.S. military campaigns since Operation Desert Storm understand the critical role that information superiority plays in modern military operations. In that conflict and others since then against conventional

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[23] See Reuben F. Johnson, "PLAAF claims China's KJ-500 AEW&C aircraft is an 'indigenous' design", *IHS Jane's Defence Review*, March 23, 2016 for a description of the latest Chinese AWACS design.

[24] David A. Shlapak, et al., *A Question of Balance: Political Context and Military Aspects of the China-Taiwan Dispute*, Santa Monica, Calif: RAND Corporation, 2009, p. 67.

[25] Shlapak et al., 2009, p. 118.

[26] United States Navy, Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, 2015, p. 12.

[27] As an example of this modernization program is the PLAN's acquisition and coproduction of the very large Ukrainian Zbur-class Landing Craft Air Cushion (LCAC). See Ridzwan Rahmat, "China debuts Zbur LCAC in show of amphibious force in South China Sea", *IHS Jane's Navy International*, July 22, 2015.

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foes, U.S. forces have been able to develop a "common operating picture" (COP) of the battlefield, providing commanders and frontline units with current information about the location and status of both enemy and friendly units. The picture is built by fusing information from myriad sources, including airborne and space-based sensors, human intelligence, and reports from friendly units. The picture is not perfectly accurate or entirely comprehensive, of course, but U.S. commanders today have far better situational awareness of a large and complex battle space than commanders have had at any time in history. Importantly, they have also been able to degrade the enemy's COP.

Potential adversaries are striving to develop similar capabilities, fielding sensor systems on satellites, unmanned aerial vehicles, and other airborne sensor platforms; building command

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in which to fuse the information from these sensors; and using multiple communication to connect these nodes with units in the field. They are also working to degrade the quality, timeliness, and reliability of the COP available to U.S. forces. China, for instance, has fielded large numbers of electronic jamming systems to degrade U.S. theater communications.[28]

[redacted]

Numerous adversaries are using cyber operations to attempt to penetrate U.S. military information networks, both to extract information and to disrupt operations. As a result, U.S. forces cannot be confident that, in a conflict with the most capable adversaries such as China, they would have an accurate and timely view of the battlefield or that they could communicate effectively at all times in the theater.

Undersea Warfare. The People's Liberation Army (PLA) Navy is building modern submarines, including nuclear-powered vessels, and equipping them with capable weapon systems, including long-range anti-ship and land-attack cruise missiles. While DoD judges that the PLA Navy's deep-water antisubmarine warfare capability "seems to lag behind its air and surface warfare capabilities," it notes that China "is working to overcome shortcomings in this and other areas."[30] Currently, the Chinese are beginning to modernize the anti-submarine warfare (ASW) capabilities of their surface fleet as well as the PLAN's fleet of maritime patrol aircraft (MPA).[31] Additionally, the PLAN is developing unmanned underwater vehicles (UUVs) that will likely have ASW applications.

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[28] J. Randy Forbes, "Caucus Brief: Chinese Military Capable of Jamming U.S. Communications System," The Congressional China Caucus, September 20, 2013.
[29] Wendell Minnick, "China Developing Capability to Kill Satellites, Experts Say," *Defense News*, August 4, 2014.
[30] Office of the Secretary of Defense, *Military and Security Developments Involving the People's Republic of China 2014*, Washington, D.C.: U.S. Department of Defense, 2014, pp. 31- 32.
[31] Gareth Jennings, "China fields new maritime patrol and anti-submarine Y-8/Y-9 variant, HIS Jane's Defence Weekly, June 29, 2015.

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intelligence support and technical assistance to help India respond to potential Chinese aggression?

Implications for Force Planning

Chinese military capabilities have become the pacing threat for the bulk of U.S. air and naval forces. Chinese forces today pose challenges to U.S. power projection operations in all five domains of warfare—air, sea, land, space, and cyberspace. Without substantial and sustained increases in investments in new equipment and operating concepts, the credibility of U.S. security guarantees to allies and partners in East Asia will continue to erode. This makes such investments a high priority for any defense strategy.

As with efforts to deter conflict in other regions, the United States is not in this alone. As noted previously, Taiwan, in particular, could greatly complicate China's deterrent calculus by better focusing its defense resources on affordable, survivable systems for defending its coastlines and airspace. Japan, Australia, Singapore, the Philippines, Vietnam, and other states in the region can likewise make important contributions to combined deterrence and defense efforts. As China has pursued more assertive policy initiatives in East Asia, it has strengthened the incentives of other states in the region to expand cooperation with the United States and with one another and to improve their own defenses.

The following is a summary of the force elements and development priorities that are most relevant to securing U.S. interests vis-à-vis China. Recommendations for steady state posture in the region are informed by the demands of deterring large-scale aggression and of thwarting encroachments on the territorial claims of U.S. allies and partners. Development priorities and forces for large-scale conflict are derived from our assessment of a future conflict involving a Chinese invasion of Taiwan. Here and in succeeding chapters, we provide specific numbers of forces that we deem appropriate for meeting the needs of each scenario. As noted in Chapter 1, these numbers are offered as a basis for estimating and comparing the approximate costs of the alternative forces provided in the final chapter; they should not be regarded as definitive estimates of force requirements for future campaigns.

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Proposed Building Blocks of U.S. Forces for China

Steady State

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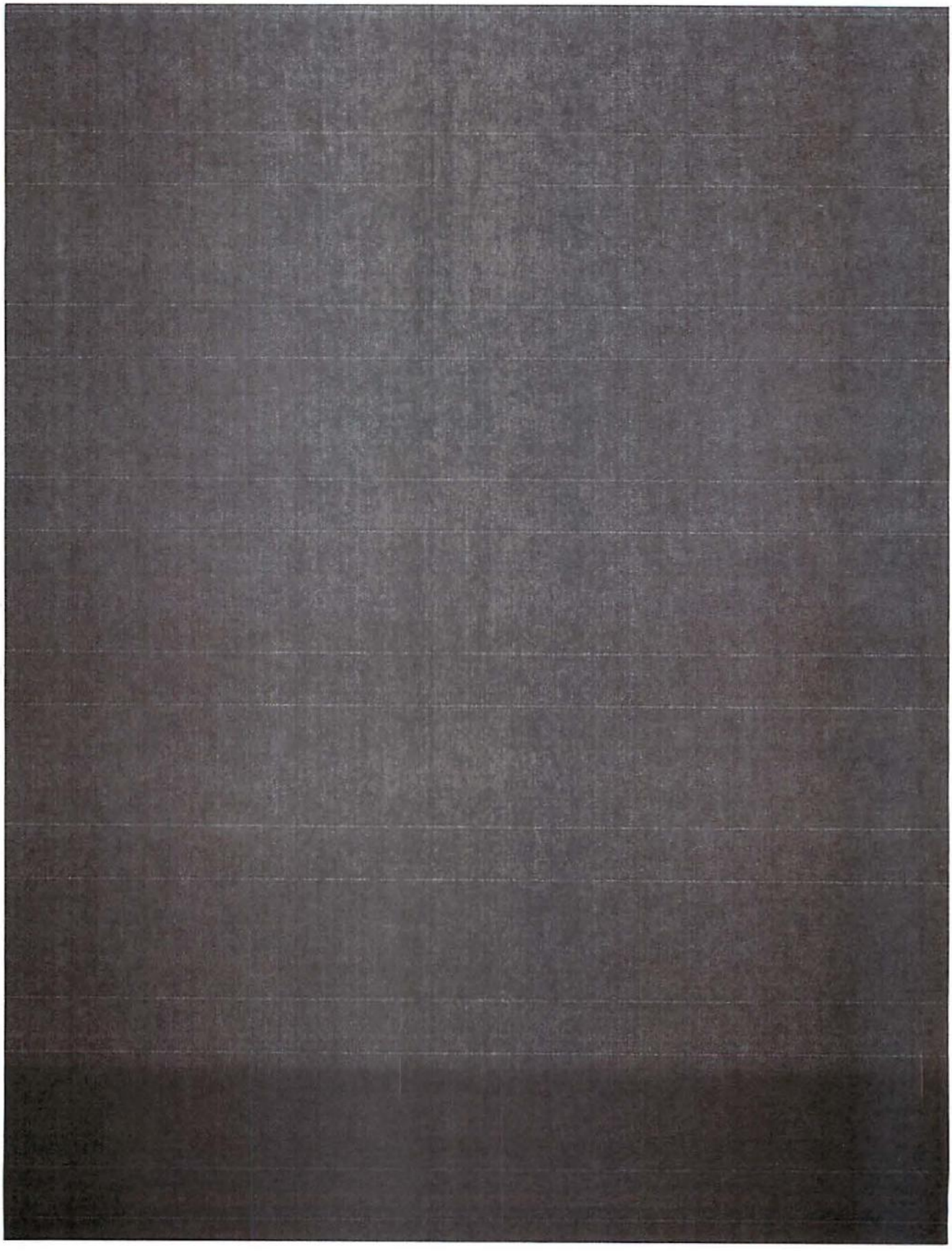

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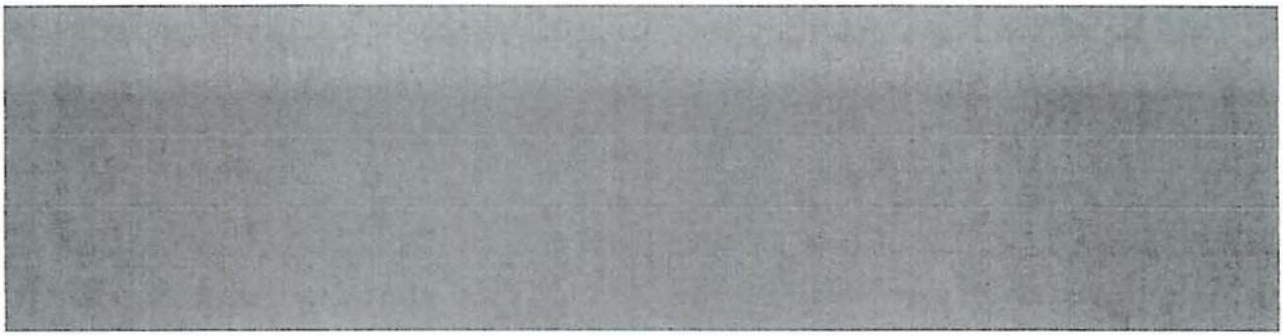

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an arsenal of perhaps 14,000 total cannon and rocket artillery systems,[137] many of which threaten Seoul with massive bombardment.[138] North Korea also possesses more than eight hundred short- and medium-range ballistic missiles.[139] That North Korea has developed such an extensive array of weaponry can be attributed to its military-first policy (*songun*): the North Korean armed forces receive preferential treatment in the distribution of societal resources.[140]

The disposition of North Korea's conventional forces is also a source of concern: more than 70 percent of North Korea's ground forces are located within 100 kilometers of the demilitarized zone (DMZ), the dividing line between North and South Korea.[141] In addition to maintaining this large conventional force, the North Korean leadership has focused on developing unconventional capabilities: Special Forces, chemical weapons, biological weapons, and nuclear weapons and delivery systems. In fact, North Korea's Special Forces are the largest in the world and could greatly complicate any conflict by striking behind South Korean lines in so-called "second front" operations.[142] North Korea's inventory of chemical weapons, estimated at 2,500 to 5,000 metric [redacted] of chemical agents and including as many as 150 warheads for ballistic missiles, could [redacted]arly render a Korean battlefield extremely lethal, especially for unprepared civilian populations.[143] North Korea could employ them early in a conflict as a gambit to slow U.S. and ROK operations, hoping to achieve quick gains.[144] [redacted]

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[redacted]

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[137] *2014 Defense White Paper*, Republic of Korea Ministry of National Defense, 2014, p. 261.

[138] *Military and Security Developments Involving the Democratic People's Republic of Korea*, 2015. p. 11.

[139] "North Korea." *The Nuclear Threat Initiative*, last updated June 2016.

[140] Alexander V. Vorontsov, "North Korea's Military-First Policy: A Curse or a Blessing," *North Korean Review*, 2006.

[141] *Military and Security Developments Involving the Democratic People's Republic of Korea*, 2015. p. 10 Similarly, Scobell and Sanford state that 80 percent of its "aggregate firepower" is within 100 miles of the DMZ. Andrew Scobell and John M Sanford, *North Korea's military threat: Pyongyang's conventional forces, weapons of mass destruction, and ballistic missiles*, Carlisle, PA: U.S. Army War College, 2007, p. xii.

[142] Scobell and Sanford, 2007, pp. xii, 1. The *Military Balance* estimates nearly 90,000 persons are in the North Korean Special Forces. The Military Balance, 2014. p. 255. The Republic of Korea's 2014 Defense White Paper estimates that North Korea possesses 200,000 special forces. *2014 Defense White Paper*, 2014, p. 29.

[143] Joseph S. Bermudez, "North Korea's Chemical Warfare Capabilities." *38 North*, October 10, 2013.

[144] [redacted]ll and Sanford, 2007, pp. 102-106.For an estimate that North Korea may have 2,500 to 5,000 tons of [redacted] weapons, see ROK Ministry of National Defense (MND), *Defense White Paper*, 2008, pp. 39–40. Found [redacted]W. Bennett, *Preparing for the possibility of a North Korean collapse*, Santa Monica, Calif: RAND, 2014, p. 4

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Potential Changes to the Steady State

The danger of North Korean nuclear weapons and ballistic missiles, especially if North Korea has indeed "miniaturized" its nuclear weapons, does justify some changes to America's peacetime posture in South Korea.[151] More forward-stationed Patriot batteries and THAAD missile defenses, whether ROK- or U.S.-operated, could help blunt the threat posed by North Korean nuclear weapons while reducing the wartime burden on scarce U.S. strategic airlift assets. The operational deployment of a THAAD system in South Korea is currently planned for 2017.[152] It is also worth considering whether the current set of ISR assets deployed in and around Korea could be enhanced to enable better monitoring and tracking of North Korean nuclear weapons and their delivery systems. Military planners should also examine the technological and doctrinal demands of a potential non-nuclear counterforce campaign that aims to quickly neutralize North Korean nuclear weapons and their associated delivery systems. The South Korean military has already begun investing in this option.[153] The United States should also consider a wide range of conventional strike capabilities for this mission.

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Some South Korean officials and commentators, in addition to a few American analysts, alled for the United States to re-deploy tactical nuclear weapons to South Korea.[154] While these advocates support sensible objectives—moderating or reversing the North Korean nuclear buildup, deterring war, and deterring nuclear use should war occur-

[redacted]

Whatever added deterrent value that nuclear weapons deployed on-peninsula might have, their benefits would have to be weighed against the risks that would result from deploying these weapons within

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Nuclear Proliferation," *Journal of Conflict Resolution*, Vol. 58, No. 3, April 1, 2014; Nuno P. Monteiro and Alexandre Debs, "The Strategic Logic of Nuclear Proliferation," *International Security*, Vol. 39, No. 2, October 1, 2014. A comparative historical study by Lyle Goldstein demonstrates the preemptive pressures unleashed by nuclear proliferation. Lyle Goldstein, *Preventive attack and weapons of mass destruction: A Comparative historical analysis*: Sanford, Calif: Stanford University Press, 2006. For an analysis that emphasizes the dangers of accidents involving nuclear weapons, especially for new nuclear weapon states, see S.D. Sagan, *Limits of safety: Organizations, accidents, and nuclear weapons*, Princeton, N.J.: Princeton University Press, 1995. We should note that there are some South Korean voices in support of nuclear weapons. See the speech of M.J. Chung, a seven-term member of South Korea's National Assembly. M.J. Chung, "Thinking the Unthinkable on the Korean Peninsula: Nuclear North Korea & Reunification," Pacific Forum CSIS, January 21, 2014.

[151] Barbara Starr and Ryan Browne, "Intel officials: North Korea 'probably' has miniaturized nuke," *CNN*, March 25, 2016. David E. Sanger and Choe Sang-Hun, "As North Korea's Nuclear Program Advances, U.S. Strategy Is Tested," *The New York Times*, May 6, 2016.

[152] Jack Kim, "South Korea, U.S. to Deploy THAAD Missile Defense, Drawing China Rebuke," *Reuters*, July 8, 2016.

[153] Zachary Keck, "With North Korean Nukes, More May Be Better," *The Diplomat*, October 4, 2013.

[154] Choe Sang-Hun, "After Tests in the North, Conservatives in South Korea Call for a Nuclear Program," *The New York Times*, 2016. and "Project Atom: A Competitive Strategies Approach to Defining U.S. Nuclear Strategy and Posture for 2025-2050," The Center for Strategic and International Studies, May 2015, p. vii.

[155] The U.S. has and will have the option of deploying a portion of its B61 family of nuclear bombs to be delivered by strategic bombers operating from Guam as part of an enhance deterrent and defense posture.

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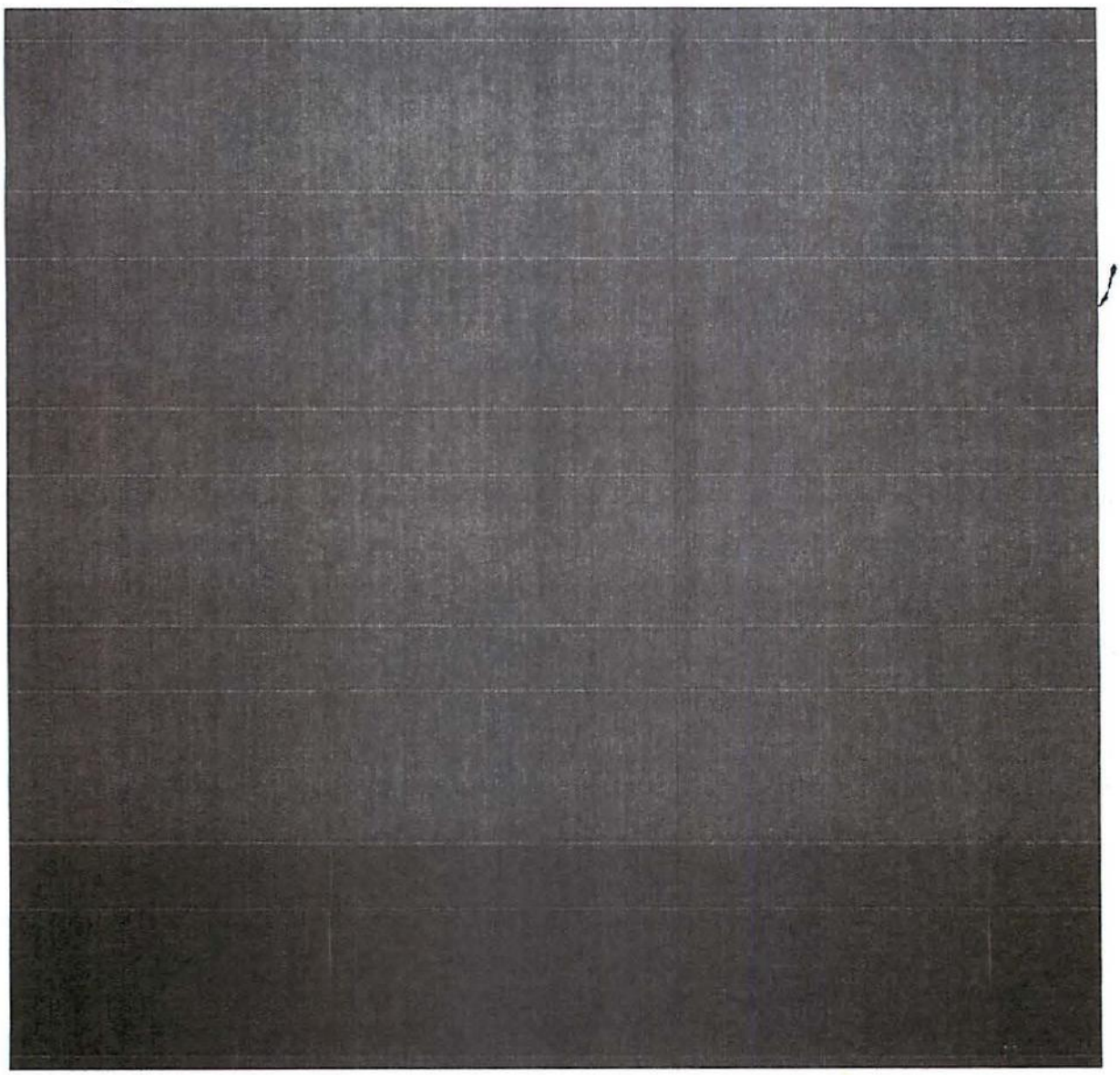
operations. He has considerable ground forces, and, even though they may not be equipped with the latest military technology, they can pose a formidable challenge. North Korea's artillery, special operations, and forward-deployed ground forces, coupled with the regime's bellicose behavior, pose serious threats to peace and stability and merit continued attention from both ROK and U.S. forces. At the same time, the allies must find ways to prevent Pyongyang from gaining decisive leverage from its growing arsenal of nuclear weapons and ballistic missiles. The force posture and investment priorities listed below are intended to address both types of challenge.

Steady State



[174] Force levels for large-scale conflict in Korea are derived from Aspin, 1993, p. 19.

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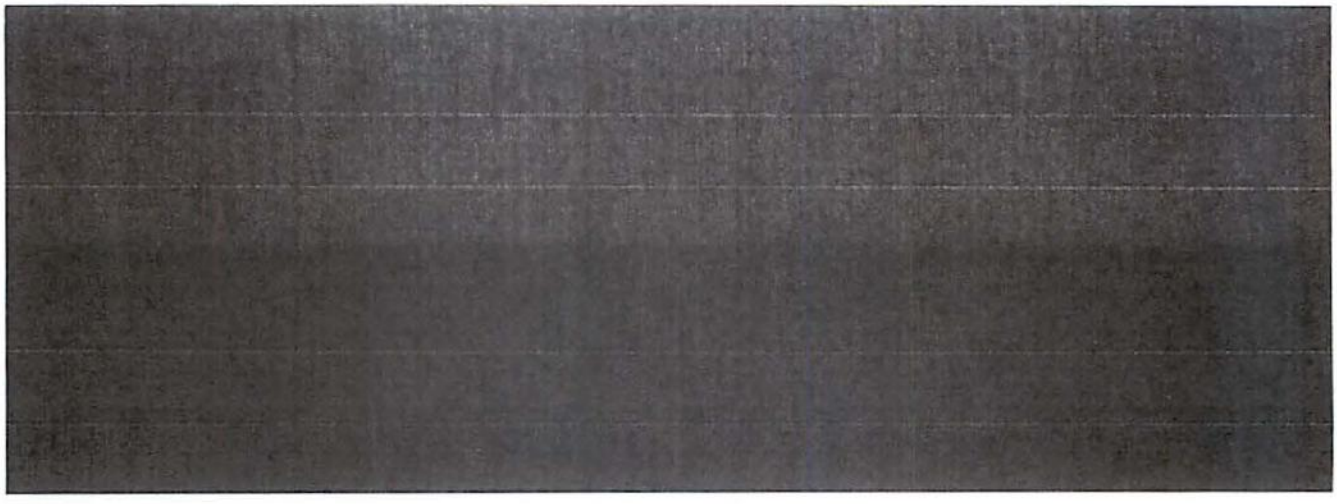

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Controllers, Combat Rescue Officers, Pararescue men, Special Operations Weather Officers and Airmen, Air Liaison Officers, and Tactical Air Control Party operators. All of these USAF personnel are often embedded with other element of USSOCOM during ongoing and rapid reaction operations.

The 27th SOW located at Cannon AFB, NM supports the subordinate 352nd and 353rd Special Operations Wings that operate from Europe (RAF Mildenhall, England) and the Pacific (Kadena Air Base, Japan). Both SOWs provide capabilities similar to those described above and found in the 24th SOW's portfolio.

The AFSOC aviation inventory presents one of the largest elements of USSOCOM's capital investment both in terms of procurement and R&D. The most expensive programs are the fleet of CV-22 VTOL aircraft and the family of heavily modified C-130 cargo aircraft: the AC-130J gunship and the MC-130 combat assault aircraft. AFSOC manages a fleet of Unmanned Aerial Vehicles (UAVs). Finally, it manages a wide spectrum of modified civilian and military aircraft [redacted] special missions in covert transportation and surveillance.

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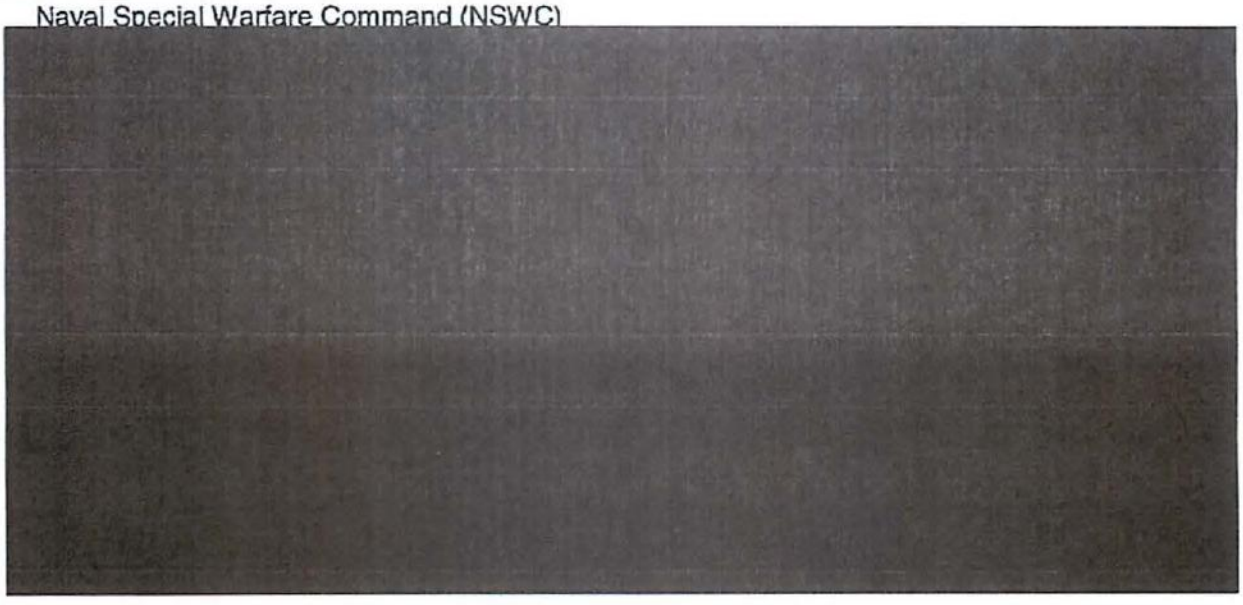
Naval Special Warfare Command (NSWC)



Marine Special Operations Command (MARSOC)

The Marine Special Operations Command (MARSOC) of approximately 3,000 personnel was created on November 1, 2005 and consists of three subordinate units: The Marine Raider Regiment that includes the 1st, 2nd, and 3rd Marine Raider Battalions, the Marine Raider Support Group, the Marine Raider Intelligence Battalion, and the Marine Raider School. On August 6, 2014 the Marine Special Operations units were renamed as Marine Raider units. The Marine Raider units can take advantage of the fact that they are fully integrated into the USN/Marine maritime Joint Force and can readily operate from a variety of Gray and Black hulled sea basing platforms.

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of submarine fleet with a number of these undersea warships specifically so modified.[255] The Army can provide additional aviation support beyond those specialized united assigned to the 160th Special Operations Aviation Regiment (Airborne) (SOAR). This aviation support will include additional combat and lift helicopters and the provision of integrated reconnaissance-strike complexes such along the design of Task Force Observe, Detect, Identify, and Neutralize (ODIN) that may be pre-deployed as the consequence on an ongoing GCC operation.[256] Finally, the Army and USMC can provide combat support such as long-range rocket artillery and engineering units as are underway in central and northern Iraq.[257]

On a global scale, the DOD and IC provide the TSOCs with a wide range of tactical, operational, and strategic intelligence. This is the provision of a globally responsive reconnaissance capacity that can be tasked by the command and operational elements of a TSOC. This global reconnaissance-strike capability has two main elements, collection and analysis. Space based collection assets as part of the National Security Space (NSS) architecture

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ned by the National Reconnaissance Office (NRO) and Naval Ocean Surveillance

OSS) with the USAF the principle service provider of the space transportation system.[258] These collection inputs are strongly supplemented by a wide range manned and unmanned aerodynamic platforms.

[redacted]

[255] The four Ohio-class SSGNs have been modified to support SOF operations using a swimmer delivery vehicle.

[256] The Army investment in the Airborne Reconnaissance Low (ARL) program can serve USSOCOM and the Intelligence Community on a wide range of ISR missions. The total cost of that program is carried in the U.S. Army budget. See Martin Streetly, "Eyes and ears in the sky: US Army Airborne Reconnaissance Low recapitalization," *IHS Jane's International Defence Review*, February 2016.

[257] See "Marines expanding combat role in Iraq, US official says", *Associated Press*, March 24, 2016 for a description of Marine artillery units operating in support of Iraqi forces from forward operating bases in northern Iraq. The U.S. Army has been providing indirect fire support from locations in Jordan, Syria, and northern Iraq with the use of the HIMARS long-range multiple rocket launchers. Also, Richard Sisk, "US Army Troops Fire HIMARS Rockets from Jordan into Syria", *DOD Buzz*, March 11, 2016; and Joseph Trevitchick, "U.S. Rocket Artillery Will Blast Islamic State From Turkey", *War is Boring*, April 29, 2016.

[258] Currently, the USAF has two certified space launch vehicle (SLV) providers, the United Launch Alliance (ULA) and the Space Exploration Corporation (SpaceX). Additional providers may be certified by the end of the decade especially those that offer much lower flight costs to orbit. Several contenders such as Orbital Science ATK, Blue Origins, and Virgin Galactic are plausible new entrants.

[259] DHS alone commands a budget FY-16 budget of $64.9 billion with 240,000 employees. See Steven Brill, "Are We Any Safer", *The Atlantic*, September 2016. An analysis of non-DoD homeland security budgets and force posture requirements including the budgets and capabilities of the U.S. Coast Guard is beyond the scope of this report.

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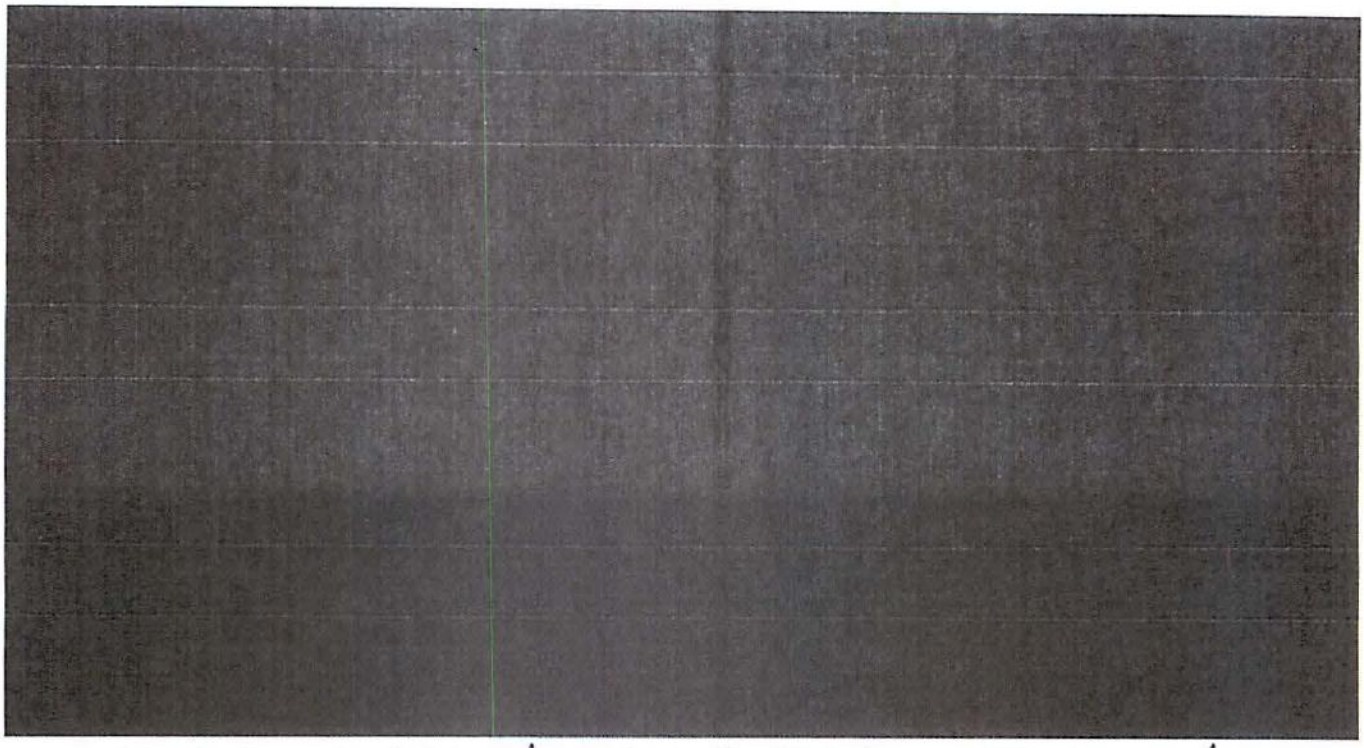
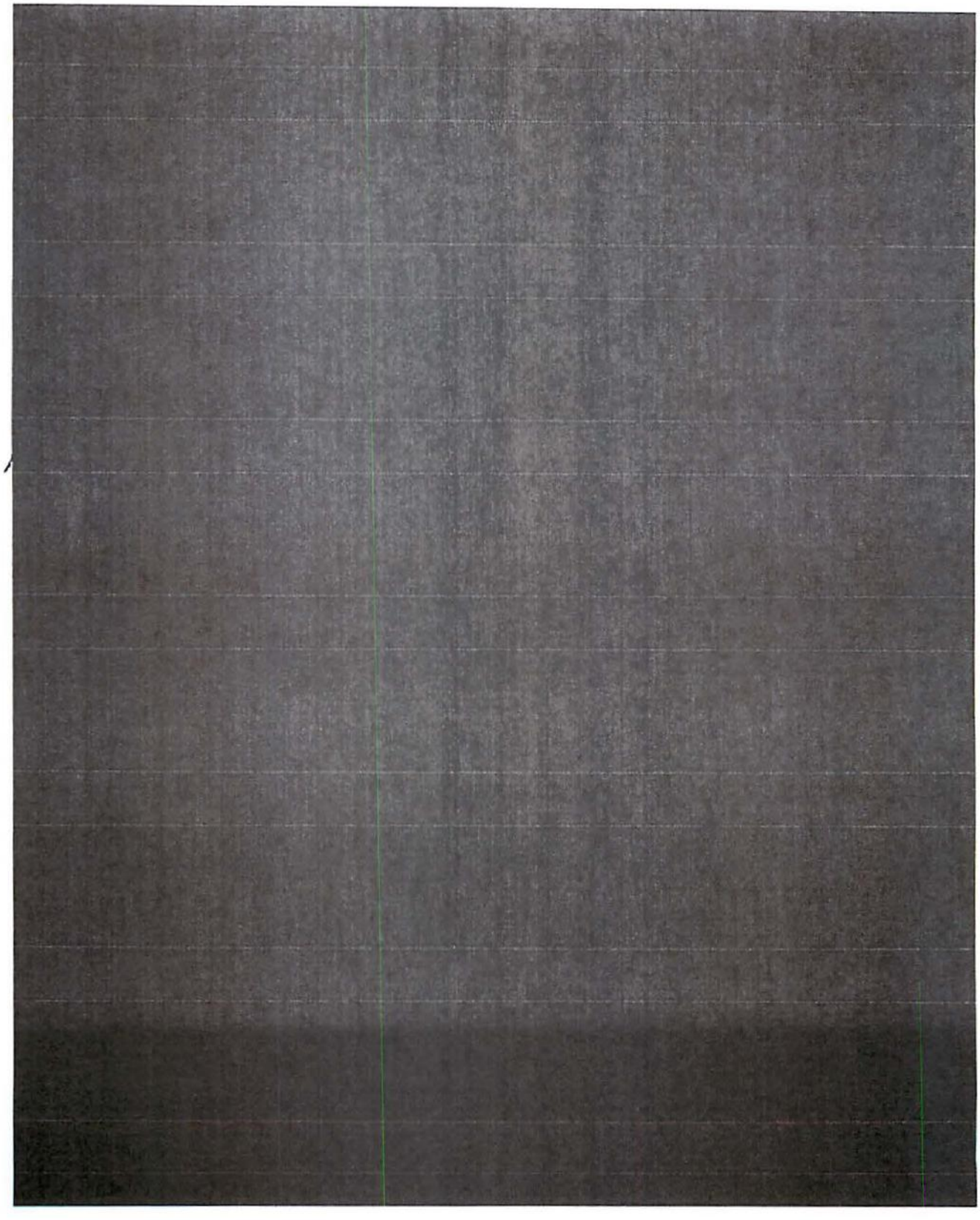


Applying the dictum that the joint force must be capable of defeating any single adversary, one would size each type of force element to meet the maximum single demand that would be placed on it (i.e., the number in the red box for that force element's row). Force building must also account for other demands that would be additive to those of a major conflict. Principally, this means accounting for forces that are routinely stationed or deployed abroad and therefore would not be readily available for deployment to a fight in another region. For example, we assume that Army ballistic missile defenses, Air Force fighter squadrons, and naval vessels in East Asia generally would not be deployed out of theater to a conflict elsewhere. Too, some parts of the force (e.g., forces recently returned to home station from extended deployments and navy ships and submarines in extended overhaul) will be unavailable for short-notice combat operations. When one applies these considerations to the task of determining the appropriately sized force for a One Major War criterion, one gets the result shown in Table 7.2 below. The right-hand column depicts the force that results from applying our One Major War criterion; the left-hand column shows the level of each force element that is programmed for fiscal year 2019. The assumptions and numbers used to derive the force levels for the One Major War force, as well as for the forces associated with our other force planning constructs, are provided in Appendix E. (Note that unclassified figures are not available for the number of high-end ISR orbits, if any, that could be generated today.)

18-L-0334/DOPSR/0018

As Amended:
Remove

Table 7.3: Priority Enhancements to U.S. Forces and Posture



18-L-0334/DOPSR/0019

create wide-area HEMP effects.[382] [redacted] As in preparing for an opponent's use of chemical and biological weapons, preparing for a low bandwidth conflict will put an additional burden on demanding "conventional" training syllabi.[384]

A related investment decision for the Joint Force is how much investment should be made in alternatives to the capabilities found in the current U.S. National Security Space (NSS) architecture and is reliance on cyberspace for the backbone of its C3 needs. Currently the USAF and USN are making an investment in long-range Global Hawk-class UAVs to provide alternative theater communication links and act as pseudo-satellites to generate PNT signals to supplement the NSS architecture.[385] Electronically control Adaptive HF radios may become very much back in vogue during the 2020s to provide global and theater-sized communication links. In a world of tight defense budgets, these back-up options may be hard to sell to the services without clear direction and intervention by the U.S. senior national security leadership.

Other Areas of Innovation

Innovation in Transoceanic Logistics – The challenge of the emerging A2/AD threats to U.S. expeditionary forces highlights the challenge to the U.S. transoceanic and intra-theater logistics capacity in time of war. Currently, U.S. forces are highly reliant on medium-speed logistic ships and wide-body airlifters to sustain any expeditionary operation. It is possible that these air and sea fleets would be subjected to an interdiction campaign by either China or Russia during future Eurasian regional war. The air fleets may be less vulnerable during transoceanic travel than logistics ships to interdiction; after all, the latter face the traditional threat of submarines and now the threat of long-range precision strike systems. On the other hand, airlift typically accounts for only about five percent of the materiel transported to theaters of major conflict. The importance of this problem has increased, especially in the European theater, where there is a new requirement to be prepared to deploy heavy ground forces equipment and

As Amended: Remove

rom CONUS as part of NATO's efforts to deter Russian aggression against the

---

[382] For a discussion of nuclear weapons effects including HEMP during a regional war see Wilson and Colby, 2007.

[redacted] runs the risk of prompting a direct nuclear response if the victim is a nuclear-armed state. On the other hand, a number of states such as Russia, Pakistan, and North Korea appear to be exploring various limited nuclear weapon use options during a future regional crisis. See Chapters 3 and 5 for a discussion of the prospect of a Eurasian regional conflict escalating to nuclear weapon use.

[384] The dramatic advances in virtual reality gaming, technical training, and mission planning systems may provide to opportunity to train forces in a combat environment that is "dirtied" by the extensive use of CNO, EW, and electromagnetic weapons that includes the limited use of nuclear weapons. See Bryant Jordan, "Virtual Reality Dome to Assess Soldier Thinking in Virtual Combat Environment", *Defense Tech*, March 18, 2016.

[385] This option is now fully developed through the Battlefield Airborne Communications Node (BACN) program of providing high capacity communications via Global Hawk UAVs. See Northrup Grumman Wins $61 Million U.S. Air Force BACN Contract, *Defense World*, April 26, 2016.

18-L-0334/DOPSR/0020

in its nuclear forces and has developed both ground mobile and submarine-based solid propellant ICBM-class weapons. Evidence suggests that the PRC may soon deploy MIRV warheads on these trans-oceanic range weapons, thereby rapidly increasing the number of operational nuclear weapons that can menace the United States.[394] The United States has not engaged in any formal nuclear arms negotiations with Beijing. Although Beijing continues to declare a no first use (NFU) policy, the prospect of more modern and diversified nuclear arsenal has to be a source of concern to Washington and its key East Asian allies.[395]

As Amended: Remove

Although the P5+1 was able to negotiate a nuclear rollback and freeze agreement with the IRI, the cause for global nuclear non-proliferation has not been helped by the continued modernization of the nuclear arsenals of India, Pakistan, [redacted] Of greatest immediate concern is the continued modernization and likely major expansion of the North Korean nuclear arsenal and its force of medium- and long-range missiles. At the present time, the Six Party Talks to denuclearize the Korean peninsula remain stalled, and the DPRK leadership appears fully committed to the expansion of its nuclear arsenal.

As Amended: Remove

In light of these realities and the pending obsolescence of key portions of its nuclear forces, United States will have little choice but to continue to modernize at least portions of its strategic nuclear forces (SNF) as well its inventory of air-delivered nuclear bombs, which constitute the totality of its NSNF arsenal. In the latter case, a portion of that arsenal is permanently deployed in NATO Europe. [redacted]

The Roles of U.S. Nuclear Weapons

The primary role of the U.S. nuclear arsenal is to deter a nuclear attack on the United States, its forces, or its allies by a nuclear-armed state. That purpose still has a clear application in the context of dealing with the nuclear arsenals of the Russian Federation and the PRC. Russia's military aggression in Europe, and NATO's response to it, underscores in particular the rationale that the deterrent power of the Triad should be supplemented with a forward-deployed NSNF posture, primarily to deter a decision by a Russian leader to use its NSNF in a limited fashion. Certainly the size of a future Triad and the U.S. NSNF posture in Europe will likely be defined by the future of U.S./NATO - Russia relations.

Currently the demands of deterring nuclear use by China are a lesser included case of Russia. That may change if the Chinese embark upon an ambitious effort to modernize and expand their nuclear forces. Another big change in the Chinese nuclear posture would flow from a decision by the Chinese political and military leadership to deploy a robust set of non-strategic nuclear forces. Although the Beijing leadership has not signaled an intention to move in these directions,

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[394] See *Military and Security Developments Involving the People's Republic of China 2016 – Annual Report to Congress*, Office of the Secretary of Defense, Reference # 117FA69, April 26, 2016

[395] For a discussion of the role of the U.S. arsenal providing extended deterrence to its Eurasian allies see Phillip Bobbitt, "The Lessons of Hiroshima for the Future of Nuclear Weapons", *STRATFOR, Global Affairs*, June 1, 2016.

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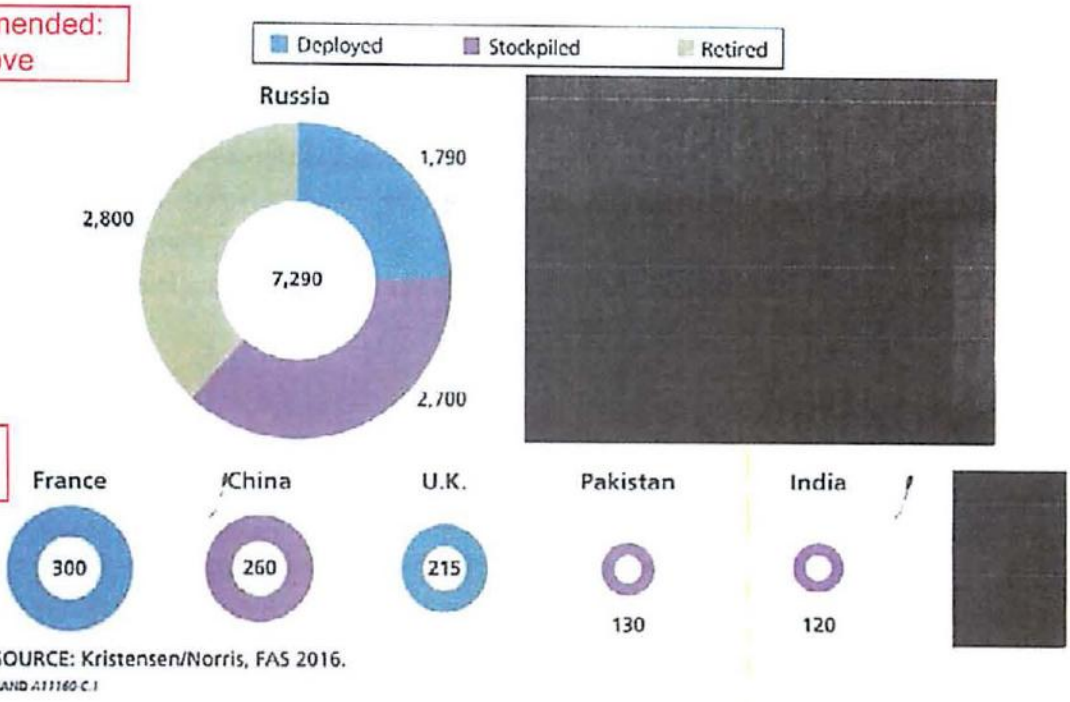
China's ongoing nuclear forces modernization program will provide that leadership with greater options by the early 2020s. Figure B.1 compares the nuclear arsenals of the declared and undeclared nuclear-armed states today.

Figure B.1: Global Inventory of Nuclear Weapons[396]

As Amended: Remove



SOURCE: Kristensen/Norris, FAS 2016.

RAND A1116O-C.1

Within the next five years, the United States may face a severe nuclear deterrence and defense challenge from North Korea. Unlike the nuclear balance between the United States and its two near-peer competitors, Russia and China, U.S. and allied leaders will be loathe to accept a relationship of mutual assured retaliation with Pyongyang. As discussed in Chapter 4, in the event of a future war between the DPRK and ROK, there is the very distinct prospect that the former might use nuclear weapons for either coercive or military effect. In those circumstances, the non-nuclear active defense and counterforce capabilities of the ROK, U.S., and Japan would be put under enormous operational strain. Following a limited use of nuclear weapons by the DPRK, the option will be on the table for the United States to employ accurate low-yield nuclear weapons as part of a comprehensive non-nuclear campaign to neutralize the North Korean nuclear arsenal and its means of delivery. Obviously, the limited use of nuclear weapons by the United States even in response to first use by North Korea is fraught with profound strategic and

[396] See Hans M. Kristensen and Robert S. Norris, "Status of World Nuclear Forces," *Federation of American Scientists (FAS)*, 2016. [redacted]
The larger number of operational B61 bombs deployed in CONUS is considered part of the number of weapons in the Stockpile category.

18-L-0334/DOPSR/0022

As Amended: Remove

Another important component of this nuclear arsenal modernization program is the refurbishment of the inventory of B-61 nuclear bombs that can be carried by the strategic bombers and a select class of USAF fighter bombers. Following a decision in the 2010 nuclear posture review the United States, in consultation with its NATO allies, decided to maintain a forward deployed NSNF posture in Europe. [redacted] A decision has been made to modernize this nuclear bomb inventory with the B61-12 variant, which will have JDAM-like precision guidance.[403] The cost of this modernization program is estimated at $8 billion over the course of the next decade.[404] As discussed in the chapter on European theater force requirements, the salience of this forward deployed nuclear arsenal has increased after the Russian decision to seize the Crimea and destabilize southeastern Ukraine.

Few would argue that the United States and its allies, at least, would be safer and more secure in a world without nuclear weapons. Regrettably, there seems to be no prospect of that world emerging in the foreseeable future. With the recent deterioration in relations between Russia and the West, North Korea's acquisition of nuclear weapons, and other developments, the maintenance of an invulnerable large-scale assured retaliation capacity to deter any nuclear attack against the United States and its treaty allies will remain an essential part of the foundation of U.S. national security. The unpredictability of the North Korean leadership and its vulnerability to conventional attack in the event of war further mean that the United States should be prepared to use a portion of its NSNF arsenal to supplement any non-nuclear counterforce campaign against North Korea's nuclear arsenal during a future conflict in Northeast Asia. There will be an ongoing debate whether the Ground Based Strategic Deterrent (GBSD) and the Long-Range Stand-Off (LSRO) cruise need to be developed and deployed. This report remains agnostic on this question, but notes that a decision to forego either option is not compelling as a means of providing budget resources for the larger non-nuclear forces investment portfolio.

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[402] The bombs are stored in hardened vaults next to the aircraft, which are based in hardened aircraft shelters. [redacted] See Emmanuelle Maitre, "NATO, the F35 and European Nuclear Dilemmas", note number 08/2016, *Foundation pour la Recherche Strategique*, February 22, 2016 and "The Forced Evolution of Europe's Tactical Nuclear Capability" *RUSI Defence Systems*, February 1, 2016, and [redacted]S. Norris and Hans M. Kristensen, "US tactical nuclear weapons in Europe, 2011", *Bulletin of the Atomic* [redacted]ts, Jan/Feb. 2011.

As Amended: Remove

[redacted]a description of this modernization option and current status of the U.S. nuclear bomb posture see Hans M. Kristensen, "B61-12: The New Guided Standoff Nuclear Bomb," Federation of American Scientists, 2015. The [redacted]

[404] For a critique of the B61 nuclear bomb life extension program see Barry Blechman and Laice Heeley, "B61 Life Extension Program – Costs and Policy Considerations," *Stimson Center*, August 2016.

18-L-0334/DOPSR/0023

Appendix E. Sizing Force Elements for Alternative Force Planning Constructs

In order to estimate the size of selected elements of the joint force appropriate for each of our three force planning constructs, we first set the "base" for each force element by specifying the level of operations they will be expected to sustain as part of the global counterterrorism effort and whatever presence they are expected to provide beyond this in key regions. We then apply the demand signal for that force element that arises from the largest three of the remaining conflict scenarios. Generally, we assume that units are not deployed out of a region where they are providing presence in order to generate forces for a conflict outside of that region. By the same token, we avoid double counting by taking account of forces that may already be in the region of each conflict due to forward presence. So, for example, the four USAF fighter squadrons stationed in the Republic of Korea are not added to the total demand for USAF fighters in a Korean conflict.

We assume that forces engaged in CT operations will require a rotation base of one unit for every one forward deployed. In time of major war, it is assumed that rotations cease and units engaged will remain engaged until the conclusion of the major war(s) and reconstitution of forces. Our "base demand," then, equals forces stationed or deployed abroad for routine presence, plus forces conducting [redacted]tions overseas, plus the CT rotation base. So, demand for a force element under the 1 Major War [redacted] will equal base demand + the largest war demand – presence in the region of that war. The following is a summary of the results of this approach for the nine major force elements that we sized.

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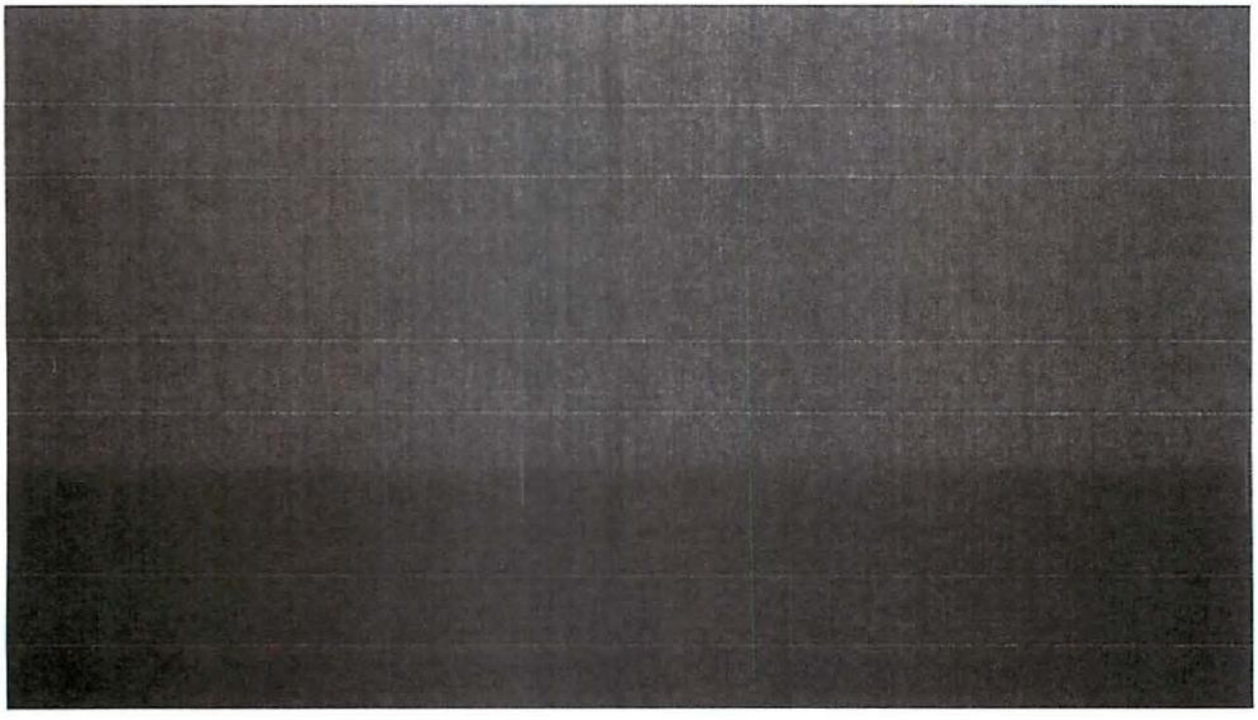

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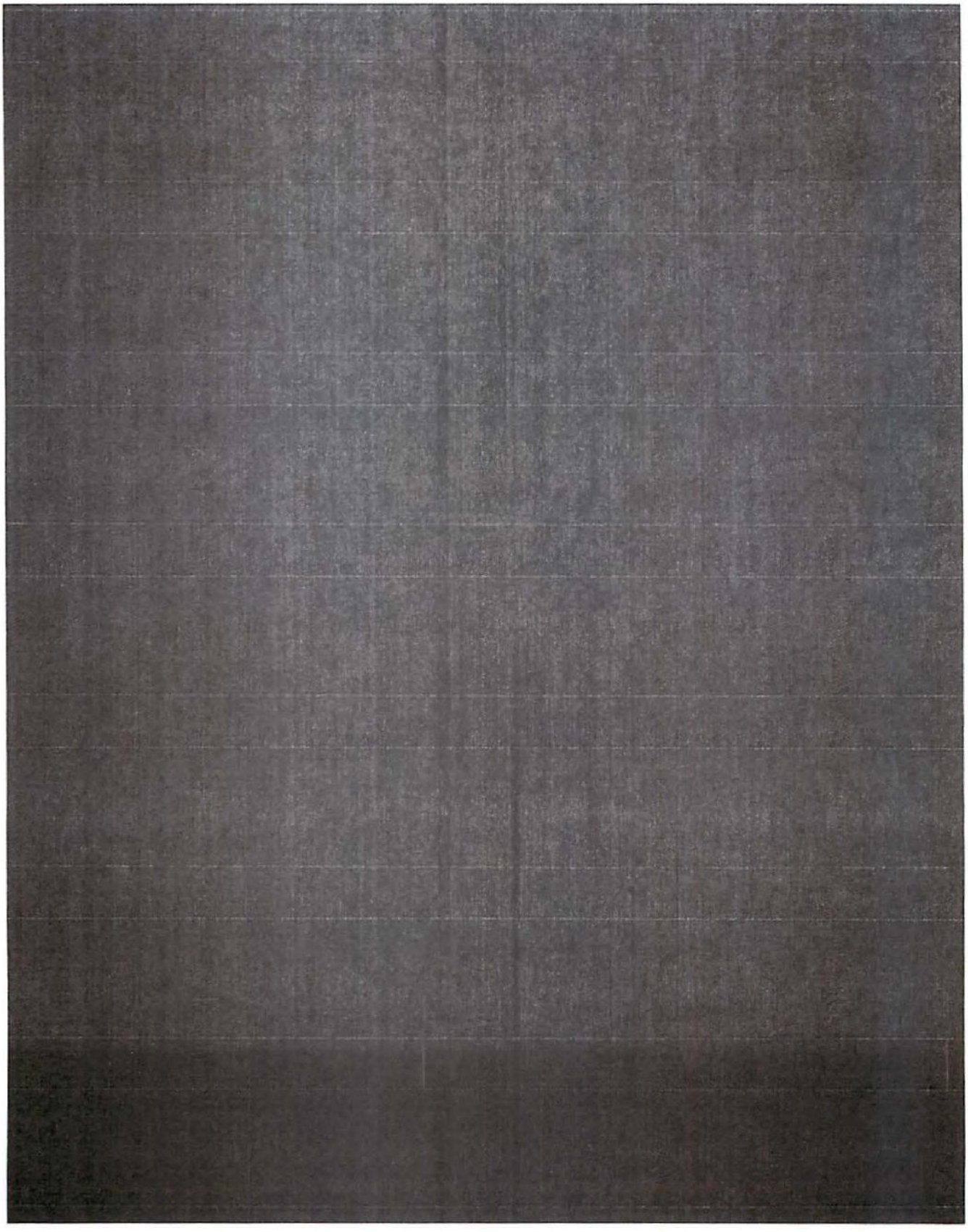

18-L-0334/DOPSR/0026

Defense Office of Prepublication & Security Review

17-S-0324/1

Coordination Record

10/26/2017

SECURITY REVIEW

To: AFRICOM -

Case Number: 17-S-0324/1

Type Of Document: PUBLICATION **# Pages:** 187 **Classsification:** Secret

Source: RAND CORPORATION **Event Date:**

Purpose: PUBLIC RELEASE **Requester:**

Subject: U. S. MILITARY CAPABILITIES AND FORCES FOR A DANGEROUS WORLD

The attached material is forwarded for review in accordance with the following guidelines. Questions concerning this case should be directed to : DAN CHYKIRDA, Room: 2A534, 7036976763, Email: daniel.j.chykirda.civ@mail.mil, Unclassified Fax: .

Please advise if reviews required other than: AFRICOM
PACOM

A reply is requested by: 11/17/2017

COORDINATION OFFICE ACTION

To: Defense Office of Prepublication & Security Review, DOPSR, Room , 2A534, 1155 Defense Pentagon, Washington, DC 20301-1155

Review by this office in accordance with guidelines below, result in the following recommendation concerning clearance for publication.

Check One:

- ☐ **No Objection as Received.**
- ☐ **Recommended Changes.**
- ☐ **No Objection Subject to Amendments** made by this office (in black pencil). Amendments and rationale (security and policy) are annotated on page numbers listed below.
- ☐ **Objection.** Amendments to permit publication are impracticable. Reasons stated below.

(Continue on reverse side if necessary)

typed name, title, organization	phone number	date	signature

Instructions: It is the policy of the Department of Defense to authorize and encourage the public release of information concerning the Department of Defense consistent with security requirements, and other exemptions to disclosure under the Freedom of Information Act.

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Editorial: Editorial review is not the responsibility of the Defense Office of Prepublication and Security Review and reviewing agencies should not make editorial corrections. However, obvious errors of fact should be indicated.

18-L-0334/DOPSR/0027

Chykirda, Daniel J CIV WHS ESD (US)

From: [redacted] CIV AFRICOM ACCS-HC (US)
Sent: Wednesday, November 8, 2017 5:22 AM
To: Chykirda, Daniel J CIV WHS ESD (US)
Subject: RE: (U) (S//FRD//NOFORN)(U//FOUO) Security Review Referral
Signed By: [redacted]@usafricom.smil.mil

UNCLASSIFIED//FOR OFFICIAL USE ONLY

Daniel,

The AFRICOM OPSEC section has completed review of green boxed info in pages XIV (page 14 in the pdf) and 111 (126 in the pdf) and conclude that this information does NOT include Critical Information as it pertains to USAFRICOM and ACI 5200.01A OPSEC. However, regarding the highlighted information and RAND's appeal that the information is a summary of Chapters 2-6, specifically Chapter 6 in this instance, recommend that USSOCOM conduct a review of the information. The information reported in Chapter 6 deals specifically with "Research and Development Activities" and "Science and Technology Information" funded and sponsored by USSOCOM, that may relate to Critical Information from a USSOCOM perspective.

V/R
[redacted]

[redacted]
FOIA/PA/Disclosure
Office of Security Management
U.S. Africa Command
DSN: 314-421-[redacted]
Commercial: +49 0711 729[redacted]

-----Original Message-----
From: Chykirda, Daniel J CIV WHS ESD (US)
Sent: Thursday, October 26, 2017 5:28 PM
To: [redacted] CIV AFRICOM ACCS-HC (US)
<[redacted]@mail.smil.mil>
Subject: RE: (S//FRD//NOFORN) (S//FRD/ACCM NICHROME SPIKE/NF) (U//FOUO) Security Review Referral

CLASSIFICATION: SECRET//FRD//NOFORN

[redacted]

Attached is an appeal for this security review, RAND accepted most of the redactions but wants some overturned. I have attached my working copy, the only redactions that have your equities are located on pages XIV (page 14 in the pdf) and 111 (126 in the pdf), which is the same information in both locations, so it should be fairly easy to go through and make a decision

18-L-0334/DOPSR/0028

based on their letter.

The file has the ACCM removed so don't worry about the two black boxes on pages 88 and 90, if you have any questions please let me know.

v/r,

Dan

Daniel Chykirda
Security Review Specialist
The Defense Office of Prepublication and Security Review
Phone: 703-697-6763
TS VOIP: 912-0269
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-----Original Message-----
From: (b)(6) CIV AFRICOM ACCS-HC (US)
Sent: Thursday, June 8, 2017 8:23 AM
To: Chykirda, Daniel J CIV WHS ESD (US)
<daniel.j.chykirda.civ@mail.smil.mil>
Subject: RE: (S//FRD/ACCM NICHROME SPIKE/NF) (U//FOUO) Security Review Referral

Dan,

Please see AFRICOM's attached input for the subject security review.

V/R
(b)(6)

(b)(6)
FOIA/PA/Disclosure
Office of Security Management
U.S. Africa Command
DSN: 314-421-(b)(6)
Commercial: +49 0711 729 (b)(6)

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From: Chykirda, Daniel J CIV WHS ESD (US)
Sent: Thursday, May 18, 2017 4:19 PM
To: (b)(6) CIV AFRICOM ACCS-HC (US)
<(b)(6) @mail.smil.mil>
Subject: RE: (S//FRD/ACCM NICHROME SPIKE/NF) (U//FOUO) Security Review Referral

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18-L-0334/DOPSR/0029

RAND NATIONAL DEFENSE RESEARCH INSTITUTE

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September 28, 2017
Ref: 17-S-0324

Mr. Darrell W. Walker
Chief, Defense Office of Prepublication and Security Review
1155 Defense Pentagon
Washington, DC 20301-1155

Mr. Walker:

This is in response to your correspondence of September 6, 2017 (copy enclosed) relating to the Office of Prepublication and Security Review response to the draft RAND publication, *U.S. Military Capabilities and Forces for a Dangerous World*.

Your office approved the publication for public release with a number of amendments. We believe that accepting several of those amendments would substantially diminish the value of the report to the defense community by obscuring key connections between the analytical approach taken in the research and its findings, as documented in the report. Since all the data used to develop the material in this report were unclassified, we request that these six deletions be restored. If denied, we request a meeting to discuss the basis for each of the decisions.

In this package, we provide a list of all the amendments made by your review, along with our response to each. In some cases, where we have accepted your deletions, we offer alternative formulations for the purpose of continuity in the narrative, along with source material for the new text, as appropriate.

We stand ready to address any questions or concerns you might have and respectfully request a response by October 20.

Thank you for your attention to this matter.

Laura H. Baldwin

Laura H. Baldwin, Ph.D.
Associate Director

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Derived From: USPACOMINST 0301.8 SCG, Dated January 10, 2014
Declassify On: 20231231

17-S-0324/1

OBJECTIVE ANALYSIS. EFFECTIVE SOLUTIONS.

DoD amendments to RAND draft *U.S. Military Capabilities and Forces for a Dangerous World*, and RAND responses to those amendments

Page xiv: Deletion of Table S.2: Priority Enhancements to U.S. Forces and Posture. This table summarizes findings from chapters two through six of the draft. All of the enhancements listed in the table are mentioned in the text of the chapters, along with the rationale for each. The reviewers did not delete any of the recommended enhancements in the text of the chapters so we do not understand why they should be deleted from the summary table. Request this deletion be restored.

(b) (1)

[redacted]

Recommend replacing with: According to DoD, the PLA is acquiring a range of new space and counterspace capabilities. These include directed energy weapons and satellite jammers, as well as a direct-ascent kinetic kill capability against satellites in low-earth orbit. PLA writings emphasize the necessity of "destroying, damaging, and interfering with the enemy's reconnaissance . . . and communications satellites."

Source: DoD, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014*, page 32.

Pages 30 - 32: Deletion of force building blocks and priority enhancements for steady state and conflict with China. If our report is to be fully credible, it is necessary to provide a first order estimate of the numbers and types of forces that would be called for -- which come from author assumptions and unclassified sources (see below) -- to deter and defeat aggression by adversary states and groups. Without this, the reader will not be able to complete the audit trail from specific scenarios to the alternative force structures posited in the draft. We note, in this chapter and elsewhere, that the numbers we offer should not be regarded as definitive estimates of force requirements for future campaigns, and that our purpose in presenting them is not to provide definitive estimates of need, but rather to show a concrete example of how our recommended approach to force sizing could be applied. The sources for our findings in this section -- which we will add as footnotes -- are RAND wargames and published analysis in David A. Shlapak, et al, *A Question of Balance: Political Context and Military Aspects of the China-Taiwan Dispute*, MG-888-SRF, RAND, 2009.

The reviewers did not delete these estimates in the chapters on NATO/Europe and Iran (see pages 49 – 51 and 80 – 81), so we do not understand why they should be deleted here. Request this deletion be restored.

18-L-0334/DOPSR/0031
17-S-0324/1

(b) (1) [redacted]

Recommend replacing with: In testimony before the House Armed Services Committee in June 2017, Defense Secretary James Mattis stated that, "North Korea's continued pursuit of nuclear weapons and the means to deliver them has increased in pace and scope." He added that "the regime's nuclear weapons program is a clear and present danger to all."

Source: Franz-Stefan Gady, "U.S. Defense Secretary: North Korea 'Most Urgent and Dangerous Threat' to U.S. Security," *The Diplomat*, June 13, 2017; http://thediplomat.com/2017/06/us-defense-secretary-north-korea-most-urgent-and-dangerous-threat-to-us-security/.

(b) (1) [redacted]

Pages 63 – 64: Deletion of force building blocks and developmental priorities for North Korea. The comments provided above regarding the deletions on pages 30 – 32 apply here verbatim. The primary source for our findings in this section is Les Aspin, *Report of the Bottom-Up Review*, U.S. Department of Defense, October 1993. Request these deletions be restored.

Page 88: Deletion of paragraph on NSWC. Accepted.

Request this paragraph be replaced with the following paragraph, which comes from U.S. Department of Defense, Special Operations University, Special Operations Force Reference Manual – Fourth Edition, The JSOU Press, MacDill AFB, Florida, June 2015.

"The Naval Special Warfare Command (NSWC) has approximately 10,000 personnel including active-duty Special Warfare operators aka SEALs, Special Warfare Combatant-craft Crewmen (SWCC), reserve personnel, support personnel, and civilians. NSWC is organized around 10 SEAL Teams, 2 SEAL Delivery Vehicle (SDV) teams and 3 Special Boat Teams. Naval Special Warfare (NSW) provides an effective means to apply counterforce in conjunction with national policy and objectives across the spectrum of hostilities from peacetime operations to limited war to general war. NSW forces focus on the conduct of the following core activities of special operations:

- Direct action
- Special reconnaissance
- Foreign internal defense
- Counterterrorism
- Information operations
- Security force assistance
- Counterinsurgency
- Activities specified by the President of the United States.

Additionally, NSW forces are involved in other activities, such as; unconventional warfare, counterdrug, personnel recovery, and special activities. NSW also provides maritime-specific special operations to meet U.S. Navy fleet requirements."

Source: U.S. Department of Defense, Special Operations University, *Special Operations Force Reference Manual – Fourth Edition*, The JSOU Press, MacDill AFB, Florida, June 2015.

(b) (1) [redacted]

Page 108: Deletion of Table 7.1: Summary of Force Levels Employed Across Five Scenarios. As noted in our comments regarding the deletions made on pages 30 – 32, if our report is to be fully credible, it is necessary to provide a first order estimate of the numbers and types of forces that would be called for to deter and defeat aggression by adversary states and groups. Sources for the force building blocks used for the China and Korea scenarios are noted above. The primary source for the force building blocks used for the NATO/Russia scenarios is David A. Shlapak and Michael W. Johnson, *Reinforcing Deterrence of NATO's Eastern Flank: Wargaming the Defense of the Baltics*, RR-1253-A, RAND, 2016. Primary source for the Iran scenarios is Michael T. Moseley, *Operation Iraqi Freedom—By the Numbers*, United States Central Command Air Forces, April 30, 2003. Noting again that we caveat the numbers provided in the draft as not definitive and for purposes of illustrating how the approach called for here could work, request that this deletion be restored.

Page 111: Deletion of Table 7.3: Priority Enhancements to U.S. Forces and Posture. This table is the same as Table S.1. It summarizes findings from chapters two through six of the draft. All of the enhancements listed in the table are mentioned in the text of the chapters, along with the rationale for each. The reviewers did not delete any of the recommended enhancements in the text of the chapters so we do not understand why they should be deleted from the summary table. Request this deletion be restored.

(b) (1) [redacted]

For accuracy, recommend the following change to the sentence: ". . . the cause of global non-proliferation has not been helped by the continued modernization of the nuclear arsenals of the acknowledged nuclear states India and Pakistan."

(b) (1) [redacted]

Page 140: Deletion of portions of Figure B.1 and associated footnote. Accepted. We will delete the figure in its entirety.

(b) (1) [redacted]

Pages 162 – 164: Deletion of Appendix E: Sizing Force Elements for Alternative Force Planning Constructs. As with the estimates of forces called for to fight in specific scenarios (the material presented in the "building blocks" sections of chapters two through 5, and summarized in Table 7.1), the reader will need the information provided in Appendix 5 in order to understand the connections between the demands of our five scenarios and the force structures presented in chapter 7. Without this material, we are asking the reader to take it on faith that our estimates of forces called for are reasonable. Request that this deletion be restored.

 18-L-0334/DOPSR/0034

DEPARTMENT OF DEFENSE
DEFENSE OFFICE OF PREPUBLICATION AND SECURITY REVIEW
1155 DEFENSE PENTAGON
WASHINGTON, DC 20301-1155

NOV 15 2017

Ref: 17-S-0324/1

RAND Corporation
Attn: Laura Baldwin
1200 South Hayes Street
Arlington, VA 22202-5050

Dear Ms. Baldwin:

This responds to your letter of September 28, 2017, appealing some of the Department of Defense (DoD) Defense Office of Prepublication and Security Review determinations regarding the manuscript "U.S. Military Capabilities and Forces for a Dangerous World." DOPSR and the relevant DoD components have completed the appellate review of the manuscript.

DOPSR agrees to the following changes proposed by the RAND Corporation in its appeal package, amendments that RAND has accepted are omitted from this list:

- Page xiv – DoD agrees to withdraw this amendment and allow public release
- Page 13 – DoD accepts RAND's alternative language
- Page 30-32 – DoD agrees to withdraw this amendment and allow public release
- Page 54 – DoD accepts RAND's alternative language
- Pages 63-64 – DoD accepts RAND's alternative language
- Page 88 – DoD accepts RAND's alternative language
- Page 108 – DoD agrees to withdraw this amendment and allow public release
- Page 111 – DoD agrees to withdraw this amendment and allow public release
- Page 139 – DoD accepts RAND's alternative language for accuracy
- Page 162-164 – DoD accepts RAND's alternative language

Upon implementation of the proposed changes and the previously agreed to amendments the manuscript is **cleared as amended** for public release.

Enclosed is a copy of the RAND appeal package and the updated cleared as amended title page of the report. You may direct any further questions to Mr. Daniel Chykirda, Security Review Specialist, by phone at (703) 697-6763 or by email: Daniel.j.chykirda.civ@mail.mil.

Sincerely,

Darrell W. Walker

Darrell W. Walker
Chief

Enclosures:
As stated

18-L-0334/DOPSR/0036

Defense Office of Prepublication & Security Review

Case Number:	17-S-0324/1	**Source:**	RAND CORPORATION		
Subject:	U. S. MILITARY CAPABILITIES AND FORCES FOR A DANGEROUS WORLD				
Purpose:	PUBLIC RELEASE	**Event Date:**		**Pages:**	187
Requester:		**Document Type:**	PUBLICATION		
Date Received:	10/23/2017	**Classification:**	Secret	**Typist:**	GOTTIS
Suspense Date:	12/06/2017	**Date Completed:**			
Reviewer's Worksheet:		**Action Officer:**	DCHYKIRDA		

Notes:

Comments: (continue on reverse side if necessary)

PACOM - As Amended (DOPSR will overrule seeMFR)
AFRICOM - no objection / withdraw amendments
In House - RAND agreed to some changes so still as Amended

OSR Action

Recommended Action	Final Action
☐ Cleared	☐ Cleared
☒ Cleared as Amended	☒ Cleared as Amended
☐ Not Cleared	☐ Not Cleared
☒ See Memo Attached CRGM 11/13/2017	☒ See Memo Attached
Initials/Date DSC / 11-13-17	Initials/Date M. Walker Signed letter

Case should be indexed under the following keywords:

18-L-0334/DOPSR/0037

November 13, 2017
Ref: 17-S-0324/1

MEMORANDUM FOR THE RECORD

SUBJECT: Security Review 17-S-0324/1 Review Decisions

RAND appealed selected amendments that DOSPR provided on the Security Review 17-S-0324 "U.S. Military Capabilities and Forces for a Dangerous World," below are DOSPR's determination on each amendment.

Page xiv - deletion of Table S.2 - AFRICOM and PACOM agree to release

Page 13 – DOPSR accepts the alternative language, official DoD source

Page 30-32 – DOSPR will overrule PACOM. DOPSR accepts RAND's rational, new citation and upon closer inspection much of the information is publically released (deployments to Darwin, B-2/B-52 continuous presence on Guam, Submarine's stationed on Guam, etc)

Page 54 – DOPSR accepts the alternative language, official DoD statement in news media

Pages 63-64 – DOPSR accepts the alternative language, official DoD source

Page 88 – DOPSR accepts the alternative language, official DoD source

Page 108 - Deletion of Table 7.1 - AFRICOM and PACOM agree to release

Page 111 – Deletion of Table 7.3 - AFRICOM and PACOM agree to release

Page 139 – DOPSR accepts the alternative language

Page 162-164 - DOSPR will overrule PACOM, this is the breakdown of aggregated information throughout the report in a table form and how RAND arrived at the force requirements

Due to DOSPR overruling the two PACOM withholding this is a grant in full for the amendments under appeal. This case will be signed out by Mr. Darrell Walker, Chief, DOSPR.

Daniel Chykirda
Security Review Specialist

Cameron Morse
Policy Team Lead

18-L-0334/DOPSR/0038

Defense Office of Prepublication & Security Review

17-S-0324/1

Coordination Record

10/26/2017

SECURITY REVIEW

To: PACOM

Case Number: 17-S-0324/1

Type Of Document: PUBLICATION **# Pages:** 187 **Classsification:** Secret

Source: RAND CORPORATION **Event Date:**

Purpose: PUBLIC RELEASE **Requester:**

Subject: U. S. MILITARY CAPABILITIES AND FORCES FOR A DANGEROUS WORLD

The attached material is forwarded for review in accordance with the following guidelines. Questions concerning this case should be directed to : DAN CHYKIRDA, Room: 2A534, 7036976763, Email: daniel.j.chykirda.civ@mail.mil, Unclassified Fax: .

Please advise if reviews required other than: AFRICOM
PACOM

A reply is requested by: 11/17/2017

COORDINATION OFFICE ACTION

To: Defense Office of Prepublication & Security Review, DOPSR, Room , 2A534, 1155 Defense Pentagon, Washington, DC 20301-1155

Review by this office in accordance with guidelines below, result in the following recommendation concerning clearance for publication.

Check One:

- ☐ **No Objection as Received.**
- ☐ **Recommended Changes.**
- ☐ **No Objection Subject to Amendments** made by this office (in black pencil). Amendments and rationale (security and policy) are annotated on page numbers listed below.
- ☐ **Objection.** Amendments to permit publication are impracticable. Reasons stated below.

(Continue on reverse side if necessary)

typed name, title, organization	phone number	date	signature

Instructions: It is the policy of the Department of Defense to authorize and encourage the public release of information concerning the Department of Defense consistent with security requirements, and other exemptions to disclosure under the Freedom of Information Act.

Security: Reviewing agencies should identify information known to be classified within the meaning of Executive Order 13526 (DoD Regulation 5200.1R) or information which in the judgement of the reviewing agency warrants classification. In the latter case, it is requested that reasons for this judgement be given and recommendations made for appropriate classification.

Policy: Material originated with the Department of Defense for public release should, in addition, be reviewed for conflict with established policies and programs of the Department of Defense or those of the national government. If change is necessary, reviewing agencies are requested to recommend acceptable substitute language where practicable, or specify needed change in sufficient detail to permit acceptable revision.

Editorial: Editorial review is not the responsibility of the Defense Office of Prepublication and Security Review and reviewing agencies should not make editorial corrections. However, obvious errors of fact should be indicated.

18-L-0334/DOPSR/0039

Chykirda, Daniel J CIV WHS ESD (US)

From: [redacted] PACOM J02HQ3 [redacted]@pacom.smil.mil>
Sent: Thursday, October 26, 2017 6:44 PM
To: Chykirda, Daniel J CIV WHS ESD (US)
Cc: [redacted] USARMY PACOM PCJ0 (US)
Subject: RE: (S//NF) Security Review Appeal (17-S-0324/1)
Signed By: [redacted]@PACOM.SMIL.MIL

Classification: SECRET//NOFORN

Dan,

After further review I see some merit in RANDs appeals. I have listed below some compromise in order to meet their needs and ensure the nation's military is kept secure.

The table on page 30-32 remove the asterisk citing in place forces.

The table in 63 and 64 lists the current posture of U.S. Forces to include information from 2017. Remove the numbers associated with the units. And the sentences referring to the THADD employment, prior to the table.

Pages 162-164 table still needs to be redacted or altered to not show where forces are currently positioned and where they will have to move to in order to meet these demands.

Everything else is good to go.

regards

-----Original Message-----
From: Chykirda, Daniel J CIV WHS ESD (US) [mailto:daniel.j.chykirda.civ@mail.smil.mil]
Sent: Thursday, October 26, 2017 5:22 AM
To: [redacted] PACOM J02HQ3
Subject: (S//FRD//NOFORN) Security Review Appeal (17-S-0324/1)

CLASSIFICATION: SECRET//FRD//NOFORN

Good Morning,

Attached is an appeal for a security review you did a few months ago, RAND accepted most of the redactions but wants some overturned. They provided additional justification and sourcing, most of the ones where they cite a RAND report means that it has been cleared for public release by DoD, so we will have to probably come off them. I have attached my working copy, I believe all your redactions are in blue, so it should be fairly easy to go through and make a decision based on their letter. They also give proposed alternative language, some of which is from official DoD or Congressional Sources so most of those should be easy to accept.

The file has the ACCM removed so don't worry about the two black boxes on pages 88 and 90, if you have any questions please let me know.

v/r,

18-L-0334/DOPSR/0040

intelligence support and technical assistance to help India respond to potential Chinese aggression?

Implications for Force Planning

Chinese military capabilities have become the pacing threat for the bulk of U.S. air and naval forces. Chinese forces today pose challenges to U.S. power projection operations in all five domains of warfare—air, sea, land, space, and cyberspace. Without substantial and sustained increases in investments in new equipment and operating concepts, the credibility of U.S. security guarantees to allies and partners in East Asia will continue to erode. This makes such investments a high priority for any defense strategy.

As with efforts to deter conflict in other regions, the United States is not in this alone. As noted previously, Taiwan, in particular, could greatly complicate China's deterrent calculus by better focusing its defense resources on affordable, survivable systems for defending its coastlines and airspace. Japan, Australia, Singapore, the Philippines, Vietnam, and other states in the region can likewise make important contributions to combined deterrence and defense efforts. As China has pursued more assertive policy initiatives in East Asia, it has strengthened the incentives of other states in the region to expand cooperation with the United States and with one another and to improve their own defenses.

The following is a summary of the force elements and development priorities that are most relevant to securing U.S. interests vis-à-vis China. Recommendations for steady state posture in the region are informed by the demands of deterring large-scale aggression and of thwarting encroachments on the territorial claims of U.S. allies and partners. Development priorities and forces for large-scale conflict are derived from our assessment of a future conflict involving a Chinese invasion of Taiwan. Here and in succeeding chapters, we provide specific numbers of forces that we deem appropriate for meeting the needs of each scenario. As noted in Chapter 1, these numbers are offered as a basis for estimating and comparing the approximate costs of the alternative forces provided in the final chapter; they should not be regarded as definitive estimates of force requirements for future campaigns.

As Amended: Remove

ɔsed Building Blocks of U.S. Forces for China

Steady State

(b) (1)

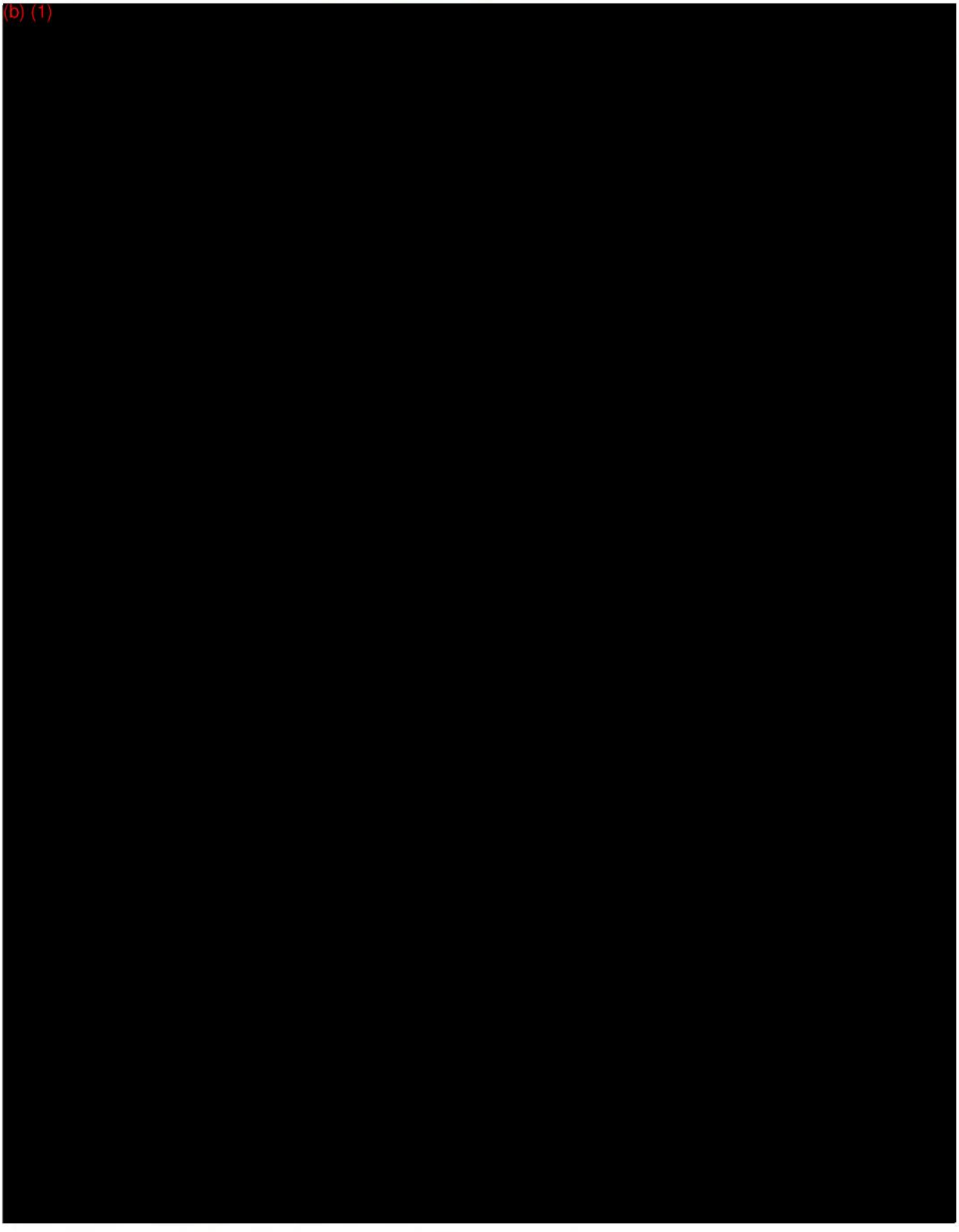
[redacted]

* In-place currently.

18-L-0334/DOPSR/0041

As Amended:
Remove

(b) (1)



18-L-0334/DOPSR/0042

As Amended:
Remove

(b) (1)

[redacted]

18-L-0334/DOPSR/0043

The Steady State

America's peacetime presence in South Korea both deters a large-scale North Korean attack and facilitates a rapid and effective U.S. military response should war or a collapse of the North Korean state occur. The forward-deployment of a heavy brigade combat team, a combat aviation, artillery, and air defense brigades, three squadrons of F-16C/Ds, and one squadron of A-10s reduces the possibility that a North Korean leader might believe that a rapid attack across the demilitarized zone could succeed.[146] Should deterrence fail, America's forward deployed forces would help to provide indications and warning of an impending attack, facilitate the deployment of large-scale U.S. reinforcements, and assist ROK forces in halting a North Korean offensive. Critical operational tasks in the opening phase of the conflict would include destroying or slowing the invading force and silencing North Korean artillery aimed at Seoul.

U.S. air forces can deploy to the region in a matter of a few days; ground forces based elsewhere, however, would only reach the theater after several weeks to months of mobilization and transport. The potential that an escalating series of tit-for-tat exchanges between North and South Korean forces could lead to a major war makes this forward presence of U.S. forces especially important.[147] A peacetime presence of both forces and headquarters staff also enables planning and liaison activities between U.S. forces and their South Korean counterparts. Finally, the U.S. forward presence signals to North Korean leaders that a conflict on the Korean peninsula would virtually guarantee the involvement of the military forces of the United States, potentially including U.S. nuclear weapons.[148]

The current U.S. peacetime posture in South Korea is fairly robust. Nearly 30,000 U.S. forces are deployed on the peninsula, providing tangible evidence of the U.S. commitment to South Korean security. U.S. forces in Japan, including a forward-deployed aircraft carrier, destroyers, F-16s, F-15s, and a Marine brigade equivalent in Okinawa, provide a further backstop against future North Korean provocations.[149] America's credible security guarantee to South Korea also reduces the incentives for South Korea to pursue its own nuclear force, a move that could catalyze further proliferation, raise the specter of preemptive conflict, and increase the odds of accidental nuclear use.[150]

---

[146] Forward-deployed forces reduce the probability of a successful North Korean attack by slowing an attack and by serving as a "tripwire," a force that, if attacked, will lead the United States to deploy a much larger force. For data on U.S. forces in South Korea, see The Military Balance, 2014, p. 55.

[147] This scenario may become increasingly likely as the leadership in Pyongyang comes to believe that its nuclear arsenal provides a deterrent against an ROK or U.S. response to a future North Korean military provocation. This sequence of events unfolded during the Kargil crisis between Pakistan and India when Pakistani leaders believed that its newfound nuclear weapons shielded Pakistan from a major Indian military response after encroachments on the line of control. Paul K. Davis, Peter A. Wilson and Jeong Eun Kim, "Deterrence and Stability for the Korean Peninsula," *Korean journal of defense analysis*, Vol. 28, No. 1, 2016.

[148] This is the same rationale for a robust forward deployed NATO peacetime presence in East Europe as made in Chapter 3 on the emergent political and military challenges to the Atlantic Alliance.

[149] The Military Balance, 2014, p. 55.

[150] For two articles that demonstrate the connection between American security guarantees and the decision of U.S. allies to not develop nuclear weapons, see Philipp C. Bleek and Eric B. Lorber, "Security Guarantees and Allied

18-L-0334/DOPSR/0044

As Amended: Remove

operations. He has considerable ground forces, and, even though they may not be equipped with latest military technology, they can pose a formidable challenge. North Korea's artillery, special operations, and forward-deployed ground forces, coupled with the regime's bellicose behavior, pose serious threats to peace and stability and merit continued attention from both ROK and U.S. forces. At the same time, the allies must find ways to prevent Pyongyang from gaining decisive leverage from its growing arsenal of nuclear weapons and ballistic missiles. The force posture and investment priorities listed below are intended to address both types of challenge.

Steady State

(b) (1)

[redacted]

[174] Force levels for large-scale conflict in Korea are derived from Aspin, 1993, p. 19.

18-L-0334/DOPSR/0045

Appendix E. Sizing Force Elements for Alternative Force Planning Constructs

In order to estimate the size of selected elements of the joint force appropriate for each of our three force planning constructs, we first set the "base" for each force element by specifying the level of [redacted]ns they will be expected to sustain as part of the global counterterrorism effort and whatever presence they are expected to provide beyond this in key regions. We then apply the demand signal for that force element that arises from the largest three of the remaining conflict scenarios. Generally, we assume that units are not deployed out of a region where they are providing presence in order to generate forces for a conflict outside of that region. By the same token, we avoid double counting by taking account of forces that may already be in the region of each conflict due to forward presence. So, for example, the four USAF fighter squadrons stationed in the Republic of Korea are not added to the total demand for USAF fighters in a Korean conflict.

As Amended: Remove

We assume that forces engaged in CT operations will require a rotation base of one unit for every one forward deployed. In time of major war, it is assumed that rotations cease and units engaged will remain engaged until the conclusion of the major war(s) and reconstitution of forces. Our "base demand," then, equals forces stationed or deployed abroad for routine presence, plus forces conducting CT operations overseas, plus the CT rotation base. So, demand for a force element under the 1 Major War FPC will equal base demand + the largest war demand – presence in the region of that war. The following is a summary of the results of this approach for the nine major force elements that we sized.

(b) (1)

[redacted]

18-L-0334/DOPSR/0046

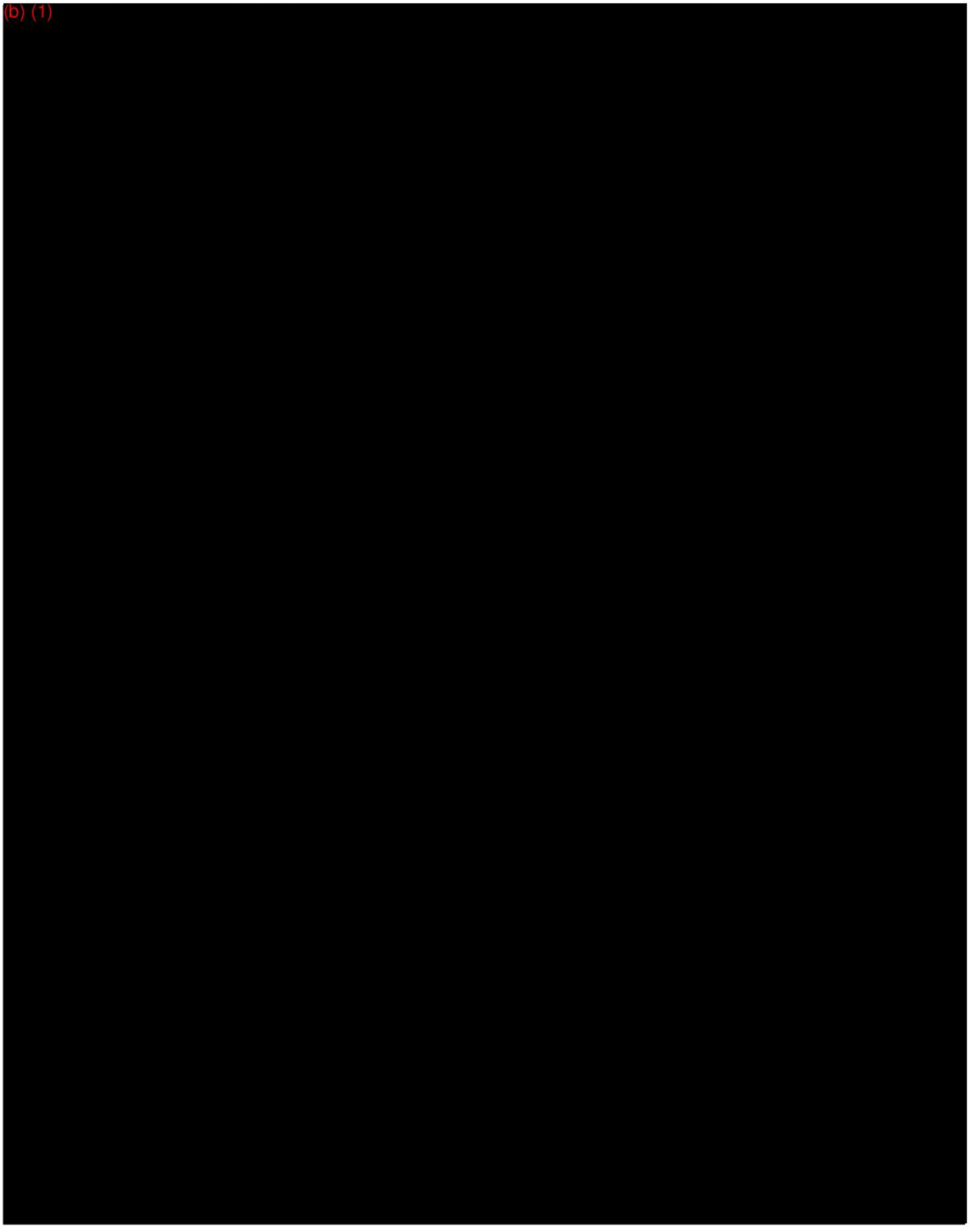
As Amended:
Remove

NOT CLEARED FOR PUBLIC RELEASE. DO NOT CITE.

(b) (1)

[redacted]

(b) (1)



18-L-0334/DOPSR/0048

Research Report

U.S. Military Capabilities and Forces for a Dangerous World

Rethinking the U.S. Approach to Force Planning

David A. Ochmanek, Peter A. Wilson, Brenna Allen, John Speed Meyers, and Carter C. Price

CLEARED As Amended
For Open Publication
NOV 13 2017 13
Department of Defense
OFFICE OF PREPUBLICATION AND SECURITY REVIEW

RAND National Security Research Division

RR-1782-IRD
October 2016
Prepared for RAND Corporation

NOT CLEARED FOR PUBLIC RELEASE

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18-L-0334/DOPSR/0049
17-S-0324

From: (b)(6) CIV USARMY HQDA OCPA (US)
To: Kluzik, Donald E CIV WHS ESD (US)
Subject: FW: Security Review status check 17-S12241 - PMR-15
Date: Thursday, December 21, 2017 2:51:12 PM

Mr. Kluzik,

Below is the response from the Army Research Lab.

V/r,

(b)(6)
OCPA

-----Original Message-----
From: (b)(6) CTR USARMY RDECOM ARL (US)
Sent: Wednesday, December 20, 2017 12:59 PM
To: (b)(6) CIV USARMY HQDA OCPA (US) <(b)(6) @mail.mil>
Subject: Security Review status check 1224A1

Afternoon (b)(6),

Thomas Moyer, Chief of Public Affairs for the Army Research Laboratory, is declining to sign off on the public release of the report entitled: Environmentally Friendly PMR-15 Replacement with Superior Performance. Mr. Moyer stated that because the Air Force Research Lab objected to the public release, that he would not override their decision.

If you should have any questions, please feel free to contact me.

Best Regards,

(b)(6)

(b)(6)
Army Research Laboratory
Spectra Tech
Administrative Specialist
Public Affairs
301.394(b)(6)
(b)(6) @mail mil

Defense Office of Prepublication & Security Review

17-S-1224/1

08/15/2017

Coordination Record

SECURITY REVIEW

To: DTSA - DTSA ATTN: (b)(6)

Case Number: 17-S-1224/1

Type Of Document: REPORT **# Pages:** 147 **Classsification:** Unclassified

Source: SERDP - (b)(6) (b)(6) **Event Date:**

Purpose: PUBLIC RELEASE **Requester:**

Subject: ENVIRONMENTALLY FRIENDLY PMR-15 REPLACEMENT WITH SUPERIOR PERFORMANCE

The attached material is forwarded for review in accordance with the following guidelines. Questions concerning this case should be directed to : DONALD KLUZIK, Room: 2A534, 7036144931, Email: donald.e.kluzik.civ@mail.mil, Unclassified Fax: 7036144956.

Please advise if reviews required other than: DTSA
SAF/PA

A reply is requested by: 09/18/2017

COORDINATION OFFICE ACTION

To: Defense Office of Prepublication & Security Review, DOPSR, Room , 2A534, 1155 Defense Pentagon, Washington, DC 20301-1155

Review by this office in accordance with guidelines below, result in the following recommendation concerning clearance for publication.

Check One:

☐ **No Objection as Received.**

☐ **Recommended Changes.**

☐ **No Objection Subject to Amendments** made by this office (in black pencil). Amendments and rationale (security and policy) are annotated on page numbers listed below.

☑ **Objection.** Amendments to permit publication are impracticable. Reasons stated below.

(Continue on reverse side if necessary) After discussing with AFRL we believe the document should be protected under Distribution C - The technical data is export controlled under at least ECCN 1E001 and/or 9E610 even if AFR-PE-4 is removed

typed name, title, organization	phone number	date	signature
(b)(6) DTSA	571372 (b)(6)	10/2/17	(b)(6)

Instructions: It is the policy of the Department of Defense to authorize and encourage the public release of information concerning the Department of Defense consistent with security requirements, and other exemptions to disclosure under the Freedom of Information Act.

Security: Reviewing agencies should identify information known to be classified within the meaning of Executive Order 13526 (DoD Regulation 5200.1R) or information which in the judgement of the reviewing agency warrants classification. In the latter case, it is requested that reasons for this judgement be given and recommendations made for appropriate classification.

Policy: Material originated with the Department of Defense for public release should, in addition, be reviewed for conflict with established policies and programs of the Department of Defense or those of the national government. If change is necessary, reviewing agencies are requested to recommend acceptable substitute language where practicable, or specify needed change in sufficient detail to permit acceptable revision.

Editorial: Editorial review is not the responsibility of the Defense Office of Prepublication and Security Review and reviewing agencies should not make editorial corrections. However, obvious errors of fact should be indicated.

From:	Kluzik, Donald E CIV WHS ESD (US)
To:	WHS Pentagon ESD Mailbox SECREV
Subject:	FW: Case 17-S-1224 Environmentally Friendly PMR-15 Replacement with Superior Performance (UNCLASSIFIED)
Date:	Monday, August 14, 2017 1:58:34 PM

Case # 17-S-1224 Appeal # 1/1 (SG)

CLASSIFICATION: UNCLASSIFIED

Please enter as an appeal.

Don Kluzik
Defense Office of Prepublication and Security Review
2A534
703-614-4931

-----Original Message-----
From: (b)(6) CIV OSD OUSD ATL (US)
Sent: Monday, August 14, 2017 1:39 PM
To: Kluzik, Donald E CIV WHS ESD (US) <donald.e.kluzik.civ@mail mil>
Cc: (b)(6) CTR (US) <(b)(6) @mail.mil>; Charles Carrigan <charles.carrigan@redhorsecorp.com>
Subject: Case 17-S-1224 Environmentally Friendly PMR-15 Replacement with Superior Performance (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

Mr. Kluzik: With respect to the above case, I would respectfully appeal the decision and ask that we get an opinion from a DoD subject matter expert who is also very familiar with the goals of the SERDP effort. (b)(6) (b)(6) CIV USARMY RDECOM ARL (US) (b)(6) @mail.mil> is a polymer chemist working at the Army Research Laboratory in Aberdeen, MD. He and his research group are also pursuing alternative chemistry to produce composite materials which do not require some of the objectionable and toxic ingredients currently in use. He might also have some ideas on how to modify the report in such a way that sensitive properties are removed from the discussion. It is our program's goal to perform research and development on topics that have an environmental aspect and are of interest to the DoD. If the research outcome is not disseminated widely then it's value is diminished. Thank you for your consideration. (b)(6)

(b)(6) .
Program Manager
SERDP-ESTCP
Weapons Systems and Platforms
(b)(6) @mail mil

CLASSIFICATION: UNCLASSIFIED
CLASSIFICATION: UNCLASSIFIED

DEPARTMENT OF DEFENSE
DEFENSE OFFICE OF PREPUBLICATION AND SECURITY REVIEW
1155 DEFENSE PENTAGON
WASHINGTON,DC 20301-1155

January 2, 2018
Ref: 17-S-1224/1

MEMORANDUM FOR THE UNDER SECRETARY OF DEFENSE ACQUISITION, TECHNOLOGY, AND LOGISTICS
OFFICE OF ASSISTANT SECRETARY OF DEFENSE FOR ENERGY, INSTALLATIONS, AND ENVIRONMENT
STRATEGIC ENVIRONMENTAL RESEARCH AND DEVELOPMENT PROGRAM
ATTENTION: (b)(6) [redacted]

SUBJECT: Security Review Request – "Environmentally Friendly PMR-15 Replacement with Superior Performance"

This office has reviewed the attached appeal of the denial of public release of the subject report and has upheld the original denial. We maintain the original determination that the report contains International Traffic in Arms Regulations (ITAR) export controlled technical data regarding resins used in aircraft parts (ITAR 121.1 (VIII)(i)).

Mark report as "DISTRIBUTION STATEMENT C. Distribution authorized to the U.S. Government and their U.S. contractors only (Export Control) (27 December 2017). Other requests shall to be referred to (United States Air Force Research Laboratory)."

Please direct any questions regarding this case to Mr. Donald Kluzik at 703-614-4931, email: donald.e.kluzik.civ@mail.mil.

for Darrell W. Walker
Chief

Attachments:
As stated

18-L-0334/DOPSR/0053

Defense Office of Prepublication & Security Review

Case Number: 17-S-1224/1 **Source:** SERDP - [redacted]

Subject: ENVIRONMENTALLY FRIENDLY PMR-15 REPLACEMENT WITH SUPERIOR PERFORMANCE

Purpose: PUBLIC RELEASE **Event Date:** **Pages:** 147

Requester: **Document Type:** REPORT

Date Received: 08/14/2017 **Classification:** Unclassified **Typist:** DKLUZIK

Suspense Date: 09/27/2017 **Date Completed:**

Reviewer's Worksheet: **Action Officer:** DKLUZIK

Agency Name	Routed Date	Due Date	Action	Remarks
DTSA	08/15/2017	09/18/2017	OBJ	Distribution C, 4-OCT-2017
SAF/PA	08/15/2017	09/18/2017	OTHER	RWOA, DTSA should respond to submitter, 18-SEP-2017
ARMY	08/15/2017	09/18/2017	OTHER	ARL, Will not review, 21-DEC-2017

Notes:

Comments: (continue on reverse side if necessary)

OSR Action

Recommended Action

- ☐ Cleared
- ☐ Cleared as Amended
- ☑ Not Cleared
- ☑ See Memo Attached

Initials/Date DK 1/2/18

Final Action

- ☐ Cleared
- ☐ Cleared as Amended
- ☑ Not Cleared
- ☑ See Memo Attached

Initials/Date WMM 1/2/2018

Case should be indexed under the following keywords:

3 of 9

17-S-1224/1

Defense Office of Prepublication & Security Review

08/15/2017

Coordination Record

SECURITY REVIEW

To: SAF/PA -

Case Number: 17-S-1224/1

Type Of Document: REPORT **# Pages:** 147 **Classsification:** Unclassified

Source: SERDP - (b)(6) (b)(6) **Event Date:**

Purpose: PUBLIC RELEASE **Requester:**

Subject: ENVIRONMENTALLY FRIENDLY PMR-15 REPLACEMENT WITH SUPERIOR PERFORMANCE

The attached material is forwarded for review in accordance with the following guidelines. Questions concerning this case should be directed to : DONALD KLUZIK, Room: 2A534, 7036144931, Email: donald.e.kluzik.civ@mail.mil, Unclassified F 036144956.

Please advise if reviews required other than: DTSA
SAF/PA

A reply is requested by: 09/18/2017

Return w/o Action
DTSA should respond to appeal.

To: Defense Office of Prepublication & Security DC 20301-1155

Review by this office in accordance with guide e for publication.

Check One:

- ☐ **No Objection as Received.**
- ☐ **Recommended Changes.**
- ☐ **No Objection Subject to Amendments** made (b)(6) (b)(6) y and policy) are annotated on page numbers listed below.
- ☐ **Objection.** Amendments to permit publication are im

(Continue on reverse side if necessary)

typed name, title, organization | phone number | date | signature

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Editorial: Editorial review is not the responsibility of the Defense Office of Prepublication and Security Review and reviewing agencies should not make editorial corrections. However, obvious errors of fact should be indicated.

Defense Office of Prepublication & Security Review

Case Number: 17-S-1442/1 **Source:** DRS - Kevin Lanotte

Subject: TENUM1280

Purpose: PUBLIC RELEASE **Event Date:** **Pages:** 2

Requester: **Document Type:** BROCHURE

Date Received: 10/17/2017 **Classification:** Unclassified **Typist:** DKLUZIK

Suspense Date: 10/30/2017 **Date Completed:**

Reviewer's Worksheet: **Action Officer:** DKLUZIK

Agency Name	Routed Date	Due Date	Action	Remarks
DTSA	10/17/2017	10/31/2017	NO OBJ	18-OCT-2017
NVESD	10/17/2017	10/31/2017	NO OBJ	19-OCT-2017

Notes:

Comments: (continue on reverse side if necessary)

CLEARED
For Open Publication
OCT 2 0 2017
Department of Defense
OFFICE OF PREPUBLICATION AND SECURITY REVIEW

OSR Action

Recommended Action

- [x] Cleared
- [ ] Cleared as Amended
- [ ] Not Cleared
- [ ] See Memo Attached

Initials/Date DK 10/20/17

Final Action

- [x] Cleared
- [ ] Cleared as Amended
- [ ] Not Cleared
- [ ] See Memo Attached

Initials/Date 10/20/2017

Case should be indexed under the following keywords:

DEPARTMENT OF DEFENSE
DEFENSE OFFICE OF PREPUBLICATION AND SECURITY REVIEW
1155 DEFENSE PENTAGON
WASHINGTON,DC 20301-1155

October 20, 2017
Ref: 17-S-1442/1

Mr. Kevin Lanotte
DRS Technologies, Incorporated
100 North Babcock Street
Melbourne, FL 32935

Dear Mr. Lanotte:

This is in response to the enclosed October 16, 2017, correspondence appealing the public release denial of the enclosed brochure titled:

- "Tenum1280"

The brochure is **APPROVED** for public release. However, this approval does not include any photograph, picture, exhibit, caption, or other supplemental material not specifically approved by this office. Our concurrence for release does not imply DoD endorsement or factual accuracy of the material.

Public dissemination of this information is subject to control by the copyright holder.

Please direct any questions regarding this case to Mr. Donald Kluzik at 703-614-4931, email: donald.e.kluzik.civ@mail.mil.

Sincerely,

for Darrell W. Walker
Chief

Enclosures:
As stated

18-L-0334/DOPSR/0057

Kluzik, Donald E CIV WHS ESD (US)

17-S-1442/1

From: (b)(6) CTR USARMY RDECOM CERDEC (US)
Sent: Thursday, October 19, 2017 10:59 AM
To: Kluzik, Donald E CIV WHS ESD (US)
Subject: FW: Security Review appeal 1442A1 (UNCLASSIFIED)
Signed By: (b)(6) @mail.mil

Classification: UNCLASSIFIED

CLASSIFICATION: UNCLASSIFIED

Case 1442A1 is approved as received.

-----Original Message-----
From: (b)(6) CIV USARMY RDECOM CERDEC (US)
Sent: Thursday, October 19, 2017 7:32 AM
To: (b)(6) CTR USARMY RDECOM CERDEC (US)
(b)(6) @mail.mil>
Subject: RE: Security Review appeal 1442A1 (UNCLASSIFIED)

No objection as received.

v/r

(b)(6)

-----Original Message-----
From: (b)(6) CTR USARMY RDECOM CERDEC (US)
Sent: Tuesday, October 17, 2017 11:20 AM
To: (b)(6) CIV USARMY RDECOM CERDEC (US)
(b)(6) @mail.mil>
Subject: FW: Security Review appeal 1442A1 (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

(b)(6)

Requesting review of the attached OSR Cases.

Thank you

(b)(6)

-----Original Message-----
From: Kluzik, Donald E CIV WHS ESD (US)
Sent: Tuesday, October 17, 2017 10:20 AM
To: (b)(6) CTR USARMY RDECOM CERDEC (US)
(b)(6) @mail.mil>
Subject: Security Review appeal 1442A1 (UNCLASSIFIED)

18-L-0334/DOPSR/0058

CLASSIFICATION: UNCLASSIFIED

Hello,

I am requesting that a security review be conducted on the enclosed appeal to case 17-S-1442. Thank you.

Don Kluzik
Defense Office of Prepublication and Security Review
2A534
703-614-4931

Comments - https://ice.disa.mil/index.cfm?fsa=card&sp=139133&s=110&dep=*DoD

CLASSIFICATION: UNCLASSIFIED

CLASSIFICATION: UNCLASSIFIED

CLASSIFICATION: UNCLASSIFIED

18-L-0334/DOPSR/0059

Defense Office of Prepublication & Security Review

17-S-1442/1

Coordination Record

10/17/2017

SECURITY REVIEW

To: DTSA - DTSA ATTN: (b)(6)

Case Number: 17-S-1442/1

Type Of Document: BROCHURE **# Pages:** 2 **Classsification:** Unclassified

Source: DRS - Kevin Lanotte **Event Date:**

Purpose: PUBLIC RELEASE **Requester:**

Subject: TENUM1280

The attached material is forwarded for review in accordance with the following guidelines. Questions concerning this case should be directed to : DONALD KLUZIK, Room: 2A534, 7036144931, Email: donald.e.kluzik.civ@mail.mil, Unclassified Fax: 7036144956.

Please advise if reviews required other than: DTSA
NVESD

A reply is requested by: 10/31/2017

COORDINATION OFFICE ACTION

To: Defense Office of Prepublication & Security Review, DOPSR, Room , 2A534, 1155 Defense Pentagon, Washington, DC 20301-1155

Review by this office in accordance with guidelines below, result in the following recommendation concerning clearance for publication.

Check One:

☒ **No Objection as Received.**

☐ **Recommended Changes.**

☐ **No Objection Subject to Amendments** made by this office (in black pencil). Amendments and rationale (security and policy) are annotated on page numbers listed below.

☐ **Objection.** Amendments to permit publication are impracticable. Reasons stated below.

(Continue on reverse side if necessary)

(b)(6)	X (b)(6)	18OCT17	(b)(6)
typed name, title, organization	phone number	date	signature

(b)(6)	571-372 (b)(6)	10/18/2017	(b)(6)

Instructions: It is the policy of the Department of Defense to authorize and encourage the public release Department of Defense consistent with security requirements, and other exemptions to disclosure under the Freedom of Information Act.

Security: Reviewing agencies should identify information known to be classified within the meaning of Executive Order 13526 (DoD Regulation 5200.1R) or information which in the judgement of the reviewing agency warrants classification. In the latter case, it is requested that reasons for this judgement be given and recommendations made for appropriate classification.

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Editorial: Editorial review is not the responsibility of the Defense Office of Prepublication and Security Review and reviewing agencies should not make editorial corrections. However, obvious errors of fact should be indicated.

LEONARDO DRS

October 16, 2017

Department of Defense
Office of Security Review
1155 Defense Pentagon
Washington, DC 20301-1155

SUBJECT: Review of TENUM1280 Product Brochure (RESUBMISSION)

To whom it may concern:

This is a resubmission of case 17-S-1442. Leonardo DRS, Inc., as represented by DRS Network & Imaging, LLC, herewith re-submits for your review the DRS Tenum1280 Product Brochure.

The Tenum1280 is a 10-micron infrared camera core with a maximum pixel array of 1312 x 1056 operating at 30Hz.

The information contained in the Product Data Sheet is unclassified, technically accurate, not company proprietary and does not contain critical or controlled technical data that could result in further detailed design, manufacture or production.

It is our understanding that Mr. Patrick Maloney of DTSA has agreed to approve the subject document for Public Release. We have also spoken with Army NVESD. We understand that they have two objections as follows:

- Reference to "Shock/Vibration: 75G (all axis) / 4.4G (three axis)"
- Reference to "backward compatibility with existing Tamarisk products"

In our opinion, neither of these references constitute Technical Data. The shock/vibration reference supports that the camera can withstand a certain impact should it be dropped. As for compatibility with Tamarisk products, this allows customers to upgrade existing Tamarisk cameras with the new Tenum1280 camera without needing to change or upgrade their system.

Should you have questions or require further information, please contact Kevin Lanotte at (214) 996-2920 or email: kevin.lanotte@drs.com.

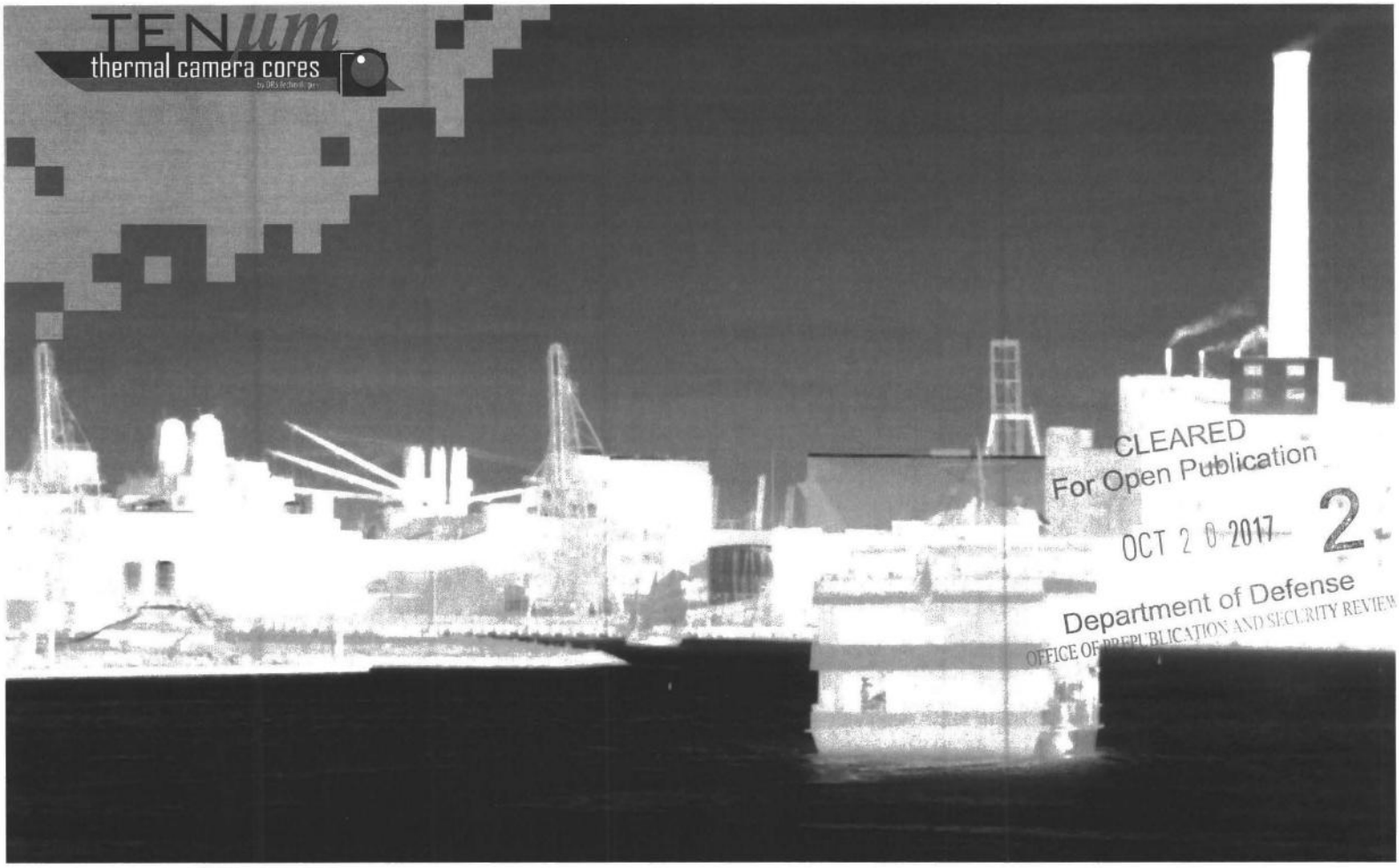
Email response is preferred and should be sent to kevin.lanotte@drs.com.

Cordially,

Kevin Lanotte
Sr. Trade Compliance Manager
DRS Electro-Optical and Infrared Systems

18-L-0334/DOPSR/0061

17-S-1442/1



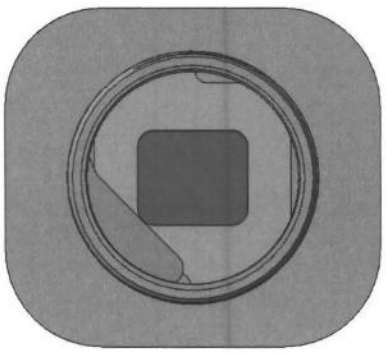
SMALL PIXELS. BIG PERFORMANCE. TENUM™ 1280

The **10-micron** technology behind the all new Tenum™ 1280 puts Leonardo DRS significantly ahead of its competitors in the race to smaller pixel pitch and lower cost products among manufacturers of infrared detectors. The Tenum™ 1280 is the **first high-resolution 10-micron thermal camera core** from DRS Technologies.

The **10-micron Vanadium Oxide (VOx) microbolometer** design is approximately **33% smaller than competing** FPAs. The design supports a variety of different lens configurations and the smaller pixel pitch of Tenum™ 1280 enables smaller, lower cost optical lens assemblies. Tenum™ 1280 offers **backward compatibility with existing Tamarisk® products** with similar interface, software protocols, feature sets, and camera control software.

DRS maintains its position of leadership through continuous innovation and a commitment to ensuring that the product performance is never compromised for lower cost solutions. As evidence, Tenum™ offers a proven **1280 x 1024 sensor** capable of performance lower than 50 mK noise equivalent temperature difference (NETd).

- 10-micron pixel pitch technology
- No-lens modules weighing as little as 50 grams
- 1280 x 1024 (SXGA), 14-bit Video
- Unmatched image quality with DRS' Patented Advanced Absorber Microbolometer Superstructure
- Integrated 3-D Noise Filter enabling high sensitivity



LEONARDO DRS

drsinfrared.com

18-L-0334/DOPSR/0062
17-S-1442/1

TENum thermal camera cores
by DRS Technologies

FOCAL PLANE ARRAY

COMPONENT	DESCRIPTION
Detector Type	Uncooled VOx Microbolometer
Array Size	1312 x 1056 max, 1280 x 1024 (SXGA) default
Pixel Pitch	10 µm
Spectral Band	7.5-14 µm
Sensitivity (NEdT) @ f/1.0 @ Room Temperature	<50 mK

ENVIRONMENTAL

COMPONENT	DESCRIPTION
Operating Temp Range	-40°C +80°C (-40°F to 176°F)
Shock / Vibration	75 G (all axis) / 4.4 G (three axis)
Humidity	5 to 95%, non-condensing
Standards Compliance	ROHS and WEEE Compliant
Sealed lens/lens mount	IP 67 at M34 Lens mount into face

VIDEO FORMAT

Frame Rate	30 Hz
Non-Uniformity Correction	1-point with shutter or through lens
Time to First Image	< 5.0 seconds
Video Output	14-bit NUC Video
Video I/O	14-bit LVCMOS or Camera Link®

POWER

Input Voltage	5.5 - 6 V Calibrated TIM 5.5 - 18 V M34 Mount
Power Dissipation Maximum Typical	 < 2.2 W Calibrated TIM 1.8 W Calibrated TIM

CONFIGURATIONS

Calibrated TIM	Detector, Bias Board, Processor Board and Shutter
M34 Mount	Calibrated TIM, Feature Board and Enclosure

STANDARD FEATURES

Available Command Protocols	LVCMOS UART
External Sync	Yes
3-D Noise Filter	User option to enable < 30 mK NETd
Dynamic Range	-40°C to 100°C

APPLICATIONS

Security / Surveillance

Automotive

Hand Held

Fire Fighting

Inspection / Drones

MODULE OPTIONS

	CONFIGURATION	WEIGHT IN GRAMS	DIMENSIONS H X W X D ±0.5 MM
	Calibrated TIM	50	46 x 46 x 19
	M34 Mount	125	53 x 64 x 36

Specifications subject to change without notice. The products described herein are subject to US Government Export Controls.
Copyright © DRS Technologies, Inc. 2017 All Rights Reserved.
Camera Link® is a registered trademark of AIA.

Rev04

LEONARDO DRS

DRS Technologies
100 N Babcock St, Melbourne, FL 32935
Tel: 855.230.2372

drsinfrared.com

CLEARANCE REQUEST FOR PUBLIC RELEASE OF DEPARTMENT OF DEFENSE INFORMATION

(See Instructions on back.)

(This form is to be used in requesting review and clearance of DoD information proposed for public release in accordance with DoDD 5230.9.)

TO: Director, Freedom of Information & Security Review, Rm. 2C757, Pentagon

1. DOCUMENT DESCRIPTION

a. TYPE	b. TITLE
Final Report	System Performance Report Underwater Advanced Time-Domain Electromagnetic System MR-201313 Appeal 17-S-2228
c. PAGE COUNT	**d. SUBJECT AREA**
31	Environmental Security Technology Certification Program (ESTCP)

2. AUTHOR/SPEAKER

a. NAME (Last, First, Middle Initial)	b. RANK	c. TITLE
Klaff, Tamir		Principal Investigator
d. OFFICE		**e. AGENCY**
		CH2M

3. PRESENTATION/PUBLICATION DATA (Date, Place, Event)

Posting on DTIC and the ESTCP web site.

CLEARED
For Open Publication

Jan 10, 2018

Department of Defense
OFFICE OF PREPUBLICATION AND SECURITY REVI

4. POINT OF CONTACT

a. NAME (Last, First, Middle Initial)	b. TELEPHONE NO. (Include Area Code)
(b)(6) [redacted]	W 571-372-(b)(6) [redacted]

5. PRIOR COORDINATION

a. NAME (Last, First, Middle Initial)	b. OFFICE/AGENCY	c. TELEPHONE NO. (Include Area Code)
Nelson, Herbert	Director	571-372-6400
Leeson, Andrea	Deputy Director	571-372-6398

6. REMARKS

THE INFORMATION CONTAINED IN THIS REPORT FALLS UNDER THE PURVIEW OF THIS OFFICE.

WHEN CLEARED, PLEASE EMAIL DD-1910 to (b)(6) [redacted] @mail.mil

if mailed: (b)(6) [redacted], 4800 Mark Center Drive Suite 17D03, Alexandria, VA 22350-3605

7. RECOMMENDATION OF SUBMITTING OFFICE/AGENCY

a. THE ATTACHED MATERIAL HAS DEPARTMENT/OFFICE/AGENCY APPROVAL FOR PUBLIC RELEASE (qualifications, if any, are indicated in Remarks section) AND CLEARANCE FOR OPEN PUBLICATION IS RECOMMENDED UNDER PROVISIONS OF DODD 5320.9. I AM AUTHORIZED TO MAKE THIS RECOMMENDATION FOR RELEASE ON BEHALF OF:

Environmental Security Technology Certification Program

b. CLEARANCE IS REQUESTED BY 20171222 (YYYYMMDD).

c. NAME (Last, First, Middle Initial)	d. TITLE
Nelson, Herbert	Executive Director
e. OFFICE	**f. AGENCY**
OASD(EI&E)	AT&L

g. SIGNATURE	h. DATE SIGNED (YYYYMMDD)
NELSON.HERBERT.HOFFMAN.1230671105 Digitally signed by NELSON.HERBERT.HOFFMAN.1230671105 Date: 2017.12.15 14:51:08 -05'00'	20171215

DD FORM 1910, MAR 1998 (EG) PREVIOUS EDITION MAY BE USED. WHS/DIOR, Mar 98

18-L-0334/DOPSR/0064

Defense Office of Prepublication & Security Review

17-S-2228/1

Coordination Record

12/18/2017

SECURITY REVIEW

To: SECDEF >> ARMY -

Case Number: 17-S-2228/1

Type Of Document: REPORT **# Pages:** 31 **Classsification:** Unclassified

Source: SERDP/ESTCP - HERBERT NELSON **Event Date:**

Purpose: PUBLIC RELEASE **Requester:** KLAFF, TAMIR

Subject: SYSTEM PERFORMANCE REPORT UNDERWATER ADVANCED TIME-DOMAIN ELECTROMAGNETIC SYSTEM

The attached material is forwarded for review in accordance with the following guidelines. Questions concerning this case should be directed to : DONALD KLUZIK, Room: 2A534, 7036144931, Email: donald.e.kluzik.civ@mail.mil, Unclassified Fax: 7036144956.

Please advise if reviews required other than: DTSA
ARMY

A reply is requested by: 01/02/2018

COORDINATION OFFICE ACTION

To: Defense Office of Prepublication & Security Review, DOPSR, Room , 2A534, 1155 Defense Pentagon, Washington, DC 20301-1155

Review by this office in accordance with guidelines below, result in the following recommendation concerning clearance for publication.

Check One:

☐ **No Objection as Received.**

☐ **Recommended Changes.**

☐ **No Objection Subject to Amendments** made by this office (in black pencil). Amendments and rationale (security and policy) are annotated on page numbers listed below.

☐ **Objection.** Amendments to permit publication are impracticable. Reasons stated below.

(Continue on reverse side if necessary)

typed name, title, organization	phone number	date	signature
(b)(6)	(b)(6)		(b)(6)

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Editorial: Editorial review is not the responsibility of the Defense Office of Prepublication and Security Review and reviewing agencies should not make editorial corrections. However, obvious errors of fact should be indicated.

18-L-0334/DOPSR/0065

From: Kluzik, Donald E CIV WHS ESD (US)
To: (b)(6) [redacted] @mail.mil"
Subject: Security Review appeal clearance 2228
Date: Wednesday, January 10, 2018 9:47:00 AM
Attachments: 17-S-2228 Appeal DD1910.pdf
MR-201313 Demonstration Report_Phase III Underwater.pdf
FW_ Appeal of Case 17-S-2228.pdf

Hello,

Attached is the clearance for the appeal of security review case 17-S-2228.

Don Kluzik
Defense Office of Prepublication and Security Review
2A534
703-614-4931

Comments - https://ice.disa.mil/index.cfm?fsa=card&sp=139133&s=110&dep=*DoD

Defense Office of Prepublication & Security Review

17-S-2228/1

Coordination Record

12/18/2017

SECURITY REVIEW

To: DTSA - DTSA ATTN: (b)(6)

Case Number: 17-S-2228/1

Type Of Document: REPORT **# Pages:** 31 **Classsification:** Unclassified

Source: SERDP/ESTCP - HERBERT NELSON **Event Date:**

Purpose: PUBLIC RELEASE **Requester:** KLAFF, TAMIR

Subject: SYSTEM PERFORMANCE REPORT UNDERWATER ADVANCED TIME-DOMAIN ELECTROMAGNETIC SYSTEM

The attached material is forwarded for review in accordance with the following guidelines. Questions concerning this case should be directed to : DONALD KLUZIK, Room: 2A534, 7036144931, Email: donald.e.kluzik.civ@mail.mil, Unclassified Fax: 7036144956.

Please advise if reviews required other than: DTSA

A reply is requested by: 01/02/2018

COORDINATION OFFICE ACTION

To: Defense Office of Prepublication & Security Review, DOPSR, Room , 2A534, 1155 Defense Pentagon, Washington, DC 20301-1155

Review by this office in accordance with guidelines below, result in the following recommendation concerning clearance for publication.

Check One:

- ☐ **No Objection as Received.**
- ☐ **Recommended Changes.**
- ☐ **No Objection Subject to Amendments** made by this office (in black pencil). Amendments and rationale (security and policy) are annotated on page numbers listed below.
- ☒ **Objection.** Amendments to permit publication are impracticable. Reasons stated below.

(Continue on reverse side if necessary)

STAFF TO NAVY
STAFF TO JIEDO

DIST. STATEMENT D
ITAR, USML TECH DATA
FOR CAT. XI(a)(7) ITEMS,
EQUIPT & SYSTEMS

(b)(6)	(b)(6)	19 DEC 17	(b)(6)
typed name, title, organization	phone number	date	signature

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18-L-0334/DOPSR/0067

[redacted] **CIV WHS ESD (US)**

From: Kluzik, Donald E CIV WHS ESD (US)
Sent: Monday, December 18, 2017 8:26 AM
To: [redacted] CIV WHS ESD (US)
Subject: 1910 for 2228 appeal
Attachments: 17-S-2228 Appeal DD1910.pdf
Signed By: donald.e.kluzik.civ@mail.mil

Importance: High

Follow Up Flag: Follow up
Flag Status: Flagged

[redacted]

Here's the DD1910 for the appeal to 17-S-2228 which came in last week.

Don Kluzik
Defense Office of Prepublication and Security Review
2A534
703-614-4931

Comments - https://ice.disa.mil/index.cfm?fsa=card&sp=139133&s=110&dep=*DoD

18-L-0334/DOPSR/0068

Defense Office of Prepublication & Security Review

Case Number: 17-S-2228/1 **Source:** SERDP/ESTCP - HERBERT NELSON

Subject: SYSTEM PERFORMANCE REPORT UNDERWATER ADVANCED TIME-DOMAIN ELECTROMAGNETIC SYSTEM

Purpose: PUBLIC RELEASE **Event Date:** **Pages:** 31

Requester: KLAFF, TAMIR **Document Type:** REPORT

Date Received: 12/18/2017 **Classification:** Unclassified **Typist:** DKLUZIK

Suspense Date: 12/22/2017 **Date Completed:**

Reviewer's Worksheet: **Action Officer:** DKLUZIK

Agency Name	Routed Date	Due Date	Action	Remarks
DTSA	12/18/2017	01/02/2018	OBJ	Route to Navy, JIEDDO, Distr bution D, 19-DEC-2017
ARMY	12/18/2017	01/02/2018	NO OBJ	10-JAN-2018
OASD EI&E	12/18/2017	12/22/2017	NO OBJ	Requestor, 10-JAN-2018

Notes:

Comments: (continue on reverse side if necessary)

OSR Action

Recommended Action

- ☐ **Cleared**
- ☐ **Cleared as Amended**
- ☐ **Not Cleared**
- ☐ **See Memo Attached**

Initials/Date _____

Final Action

- ☒ **Cleared**
- ☐ **Cleared as Amended**
- ☐ **Not Cleared**
- ☐ **See Memo Attached**

Initials/Date DK 10-JAN-2018

Case should be indexed under the following keywords: _____

From: Kluzik, Donald E CIV WHS ESD (US)
To: WHS Pentagon ESD Mailbox SECREV
Subject: FW: Appeal of Case 17-S-2228
Date: Thursday, December 14, 2017 2:58:36 PM

Please enter this as an appeal.

Don Kluzik
Defense Office of Prepublication and Security Review
2A534
703-614-4931

Comments - https://ice.disa.mil/index.cfm?fsa=card&sp=139133&s=110&dep=*DoD

-----Original Message-----
From: Nelson, Herbert H CIV OSD OUSD ATL (US)
Sent: Thursday, December 14, 2017 2:50 PM
To: Kluzik, Donald E CIV WHS ESD (US) <donald.e.kluzik.civ@mail.mil>
Cc: (b)(6) CTR OSD OUSD ATL (US) <(b)(6)@mail.mil>
Subject: Appeal of Case 17-S-2228

Mr. Kluzik - We recently received your office's decision in Case 17-S-2228 in which you directed that the subject report, "System Performance Report Underwater Advanced Time-Domain Electromagnetic System," be marked with Distribution Statement D. I believe this is more restrictive than required and ask that you reconsider the decision.

As we discussed in your office several months ago, electromagnetic induction sensors are of no interest to the Navy (they have no ASW or Countermine use) so there is no Navy SME to refer you to for another opinion. In a previous case a couple of years ago, I suggested that (b)(6)@erdc.usace.army.mil) from the Army's Cold Regions Research Lab would be a good SME to consult on this. I don't know if that suggestion proved useful but, if so, I would suggest you consult him again.

Thanks for your consideration of this appeal.

Herb

****
Herb Nelson
Director and Program Manager for Munitions
SERDP & ESTCP
571-372-6400 (V)
(b)(6) (C)

Memorandum for the Record

17-S-2228/1

19 December 2017

DTSA responded with an objection on 12/19, requesting routing to Navy and JIEDDO. Navy cleared original case prior to appeal, so no need to re-route. Submitter states that technology described in case has no use in mine warfare, so no justification to route to JIEDDO.

10 January 2018

Army responded with No Objection. Due to reasons mentioned above regarding DTSA response, DOPSR will close with No Objection.

FINAL

System Performance Report Underwater Advanced Time-Domain Electromagnetic System MR-201313

Prepared for

Environmental Security Technology Certification Program (ESTCP)

March 2017

ch2m:
2411 Dulles Corner Park
Suite 500
Herndon, Virginia 20171

18-L-0334/DOPSR/0072
17-S-2228

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Acknowledgments

The CH2M project team for the underwater testing at the Naval Surface Warfare Center Panama City Division (NSWC-PCD) included the following Key Personnel who all played an integral role.

Name	Affiliation	Responsibilities
Tamir Klaff	CH2M	Principal Investigator
Kelsey Dubois	Geometrics	Project Engineer
Nick Odlum	Geometrics	Application Geophysicist
John Nichols	Geometrics	Project Engineer
Tom Bell	Leidos	Data Analysis and Reporting
Bruce Barrow	Acorn SI	Data Analysis and Reporting
Ray Lim	NSWC PCD	Site Coordinator

CH2M would also like to thank NSWC-PCD staff Lisa Arrieta and Russ Malcolm and the dive support team, led by Steve Lowe, for their fantastic support during the field operation.

System Performance Report

Introduction

This document has been prepared under Environmental Security Technology Certification Program (ESTCP) Project MR-201313, titled Underwater Advanced Time-Domain Electromagnetic System, to present results of the system evaluation performed by CH2M HILL, Inc. (CH2M) at the Naval Surface Warfare Center (NSWC) Panama City Division's (PCD's) freshwater pond facility in October 2016. The intent of the testing was to perform a field evaluation of the system designed and constructed in the initial phases of the project.

Project Description

The overall objective of the project is to design, build and demonstrate an underwater advanced time-domain electromagnetic (TEM) system for cued classification of munitions in the underwater environment. The phased approach consists of initial design and modeling (Phase 1 –completed), engineering design and construction (Phase 2 –completed), underwater evaluation of the system (Phase 3 – described in this document), and an optional Phase 4 demonstration of the system at a field site.

Technology

The system designed and constructed under this project has been described in detail in prior documents, titled *Modeling for Underwater Advanced Time-Domain Electromagnetic System* (June, 2014), *Underwater Advanced Time-Domain Electromagnetic System Design* (July, 2015), and in the *Underwater Advanced Time-Domain Electromagnetic System Evaluation Plan* (October, 2016). A diagram of the system, as tested, is provided as **Figure 1**. A photograph of the system is provided as **Figure 2**.

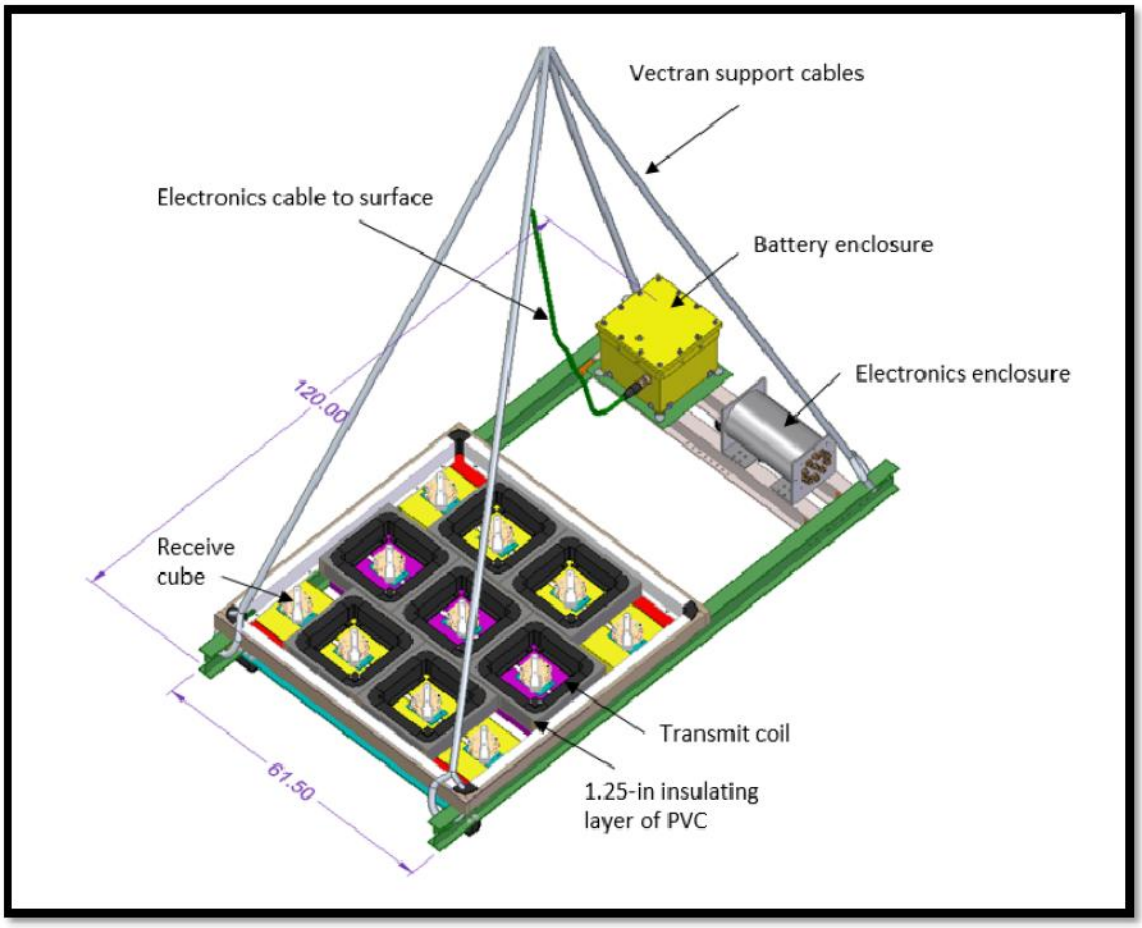

Figure 1. Underwater Advanced Time-Domain Electromagnetic System. Measurements are in inches.

Figure 2. Photograph of Underwater Advanced Time-Domain Electromagnetic System

Figure 3 presents a diagram identifying transmitter (Tx) and receiver (Rx) locations and nomenclature. The array consists of eleven 10 centimeter (cm) three-axis receive cubes, denoted by the cube identifier and an "r" indicating "receiver" (i.e. Ar-Kr), seven 40 cm square transmit coils, denoted by the cube identifier and a "t" indicating "transmitter" (i.e. At-Gt), and an outer 1.56 m square transmit coil (Ht). The resulting total number of data channels is 264. The raw sampling interval used for the evaluation was 0.004 ms and the recorded data were logarithmically averaged over 5% windows, resulting in 99 logarithmically spaced decay times ranging from 0.05 milliseconds (ms) to 8.124 ms. One hundred measurements were averaged for each recorded measurement.

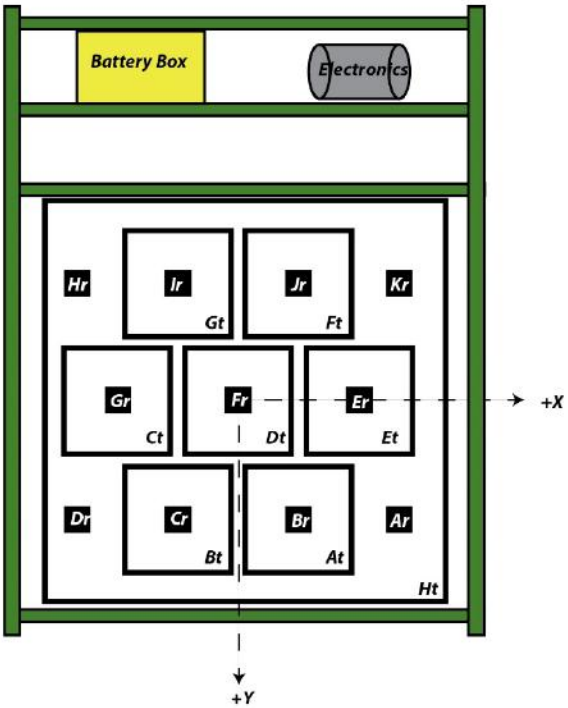

Figure 3. Transmitter and receiver locations and nomenclature.

Facility and Support

Dive operations, crane support, and general logistical support were provided by NSWCPCD. The NSWCPCD pond, shown by **Figure 4**, is 110 meter (m) wide by 80 m long and 13.5 m deep. A 30 m by 50 m bed of sand is located in the center of the pond. The pond was "shocked" on October 5, 2016 with 1800 pounds (lbs) of Calcium Hypochlorite followed by 12 cases of flocculent on October 7, 2016; however, by October 12 when the system was first introduced into the water the visibility was limited to a few feet and there was almost no visibility at times for the divers when the test bed sediment was disturbed by their activities.

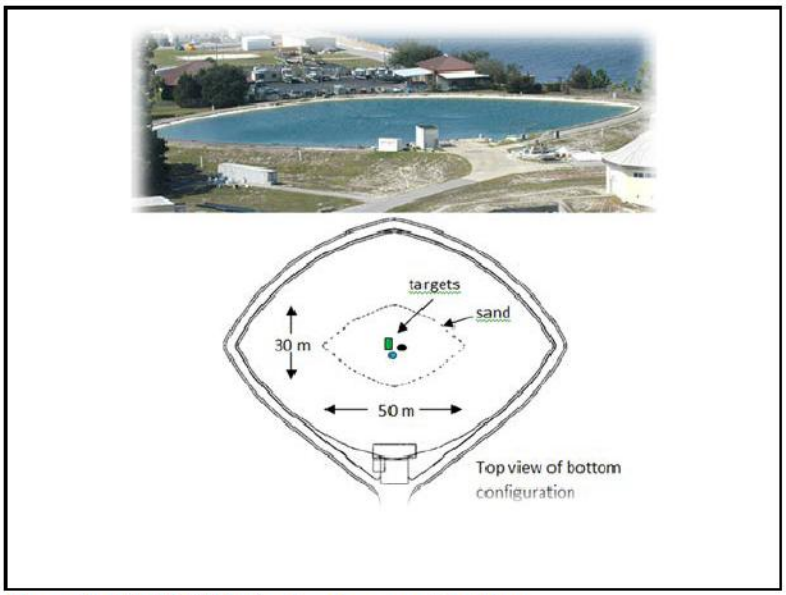

Figure 4. NSWCPCD's freshwater pond facility.

NSWCPCD provided a crane (see **Figure 5**), operator, and riggers for deployment of the system into and out of the pond, an inner-tube shallow water lift system with a 2500lb lift capacity crane (see **Figure 6**), and a team of divers to maneuver the inner-tube and the system.

Figure 5. Crane provided by NSWCPCD for transfer of system from land into water.

Figure 6. Inner-tube shallow water lift system and dive team for maneuvering system from within the water.

System Setup and Testing

CH2M and its subcontractors, Geometrics Inc. (Geometrics) and Leidos, mobilized to NSWCPCD on October 10, 2016. System setup, initial sensor function tests, and establishment of an underwater test strip were performed on October 11, 2016. In-water tests on October 12 and 13 included background response measurements, board tests to check the accuracy of target locations and polarizabilities determined by inverting array data under controlled conditions, and buried target measurements.

Test Strip

A test strip, shown by **Figure 7**, was established by the dive team on October 11, 2016 along the north-south centerline of the pond using a rope and markers on the rope with objects buried at the marked locations beneath the surface of the sand. Objects were spaced at approximately 10 m increments to allow for enough space in between them for the collection of background measurements. The objects buried, photographs of which are shown in **Figure 8**, approximate depths, and their placement orientations consisted of:

1. Large industry standard object (ISO) (4-inch x 12-inch steel pipe[1]), approximately 1-2 foot depth, long axis approximately 30 degrees from the strip centerline
2. 105-millimeter projectile, approximately 1-2 foot depth, long axis oriented parallel to the strip centerline
3. 105-millimeter High Explosive Anti-Tank (HEAT) projectile, approximately 1-2 foot depth, long axis approximately 30 degrees from the strip centerline
4. 3-inch by 12-inch aluminum rod, approximately 6 inches depth, with its long axis approximately 30 degrees from the strip centerline
5. Medium ISO (2-inch x 8-inch steel pipe[2]), approximately 6 inches depth, with its long axis approximately 30 degrees from the strip centerline

[1] https://www.mcmaster.com/#44615k137/=155225y

[2] https://www.mcmaster.com/#44615k529/=15525a7

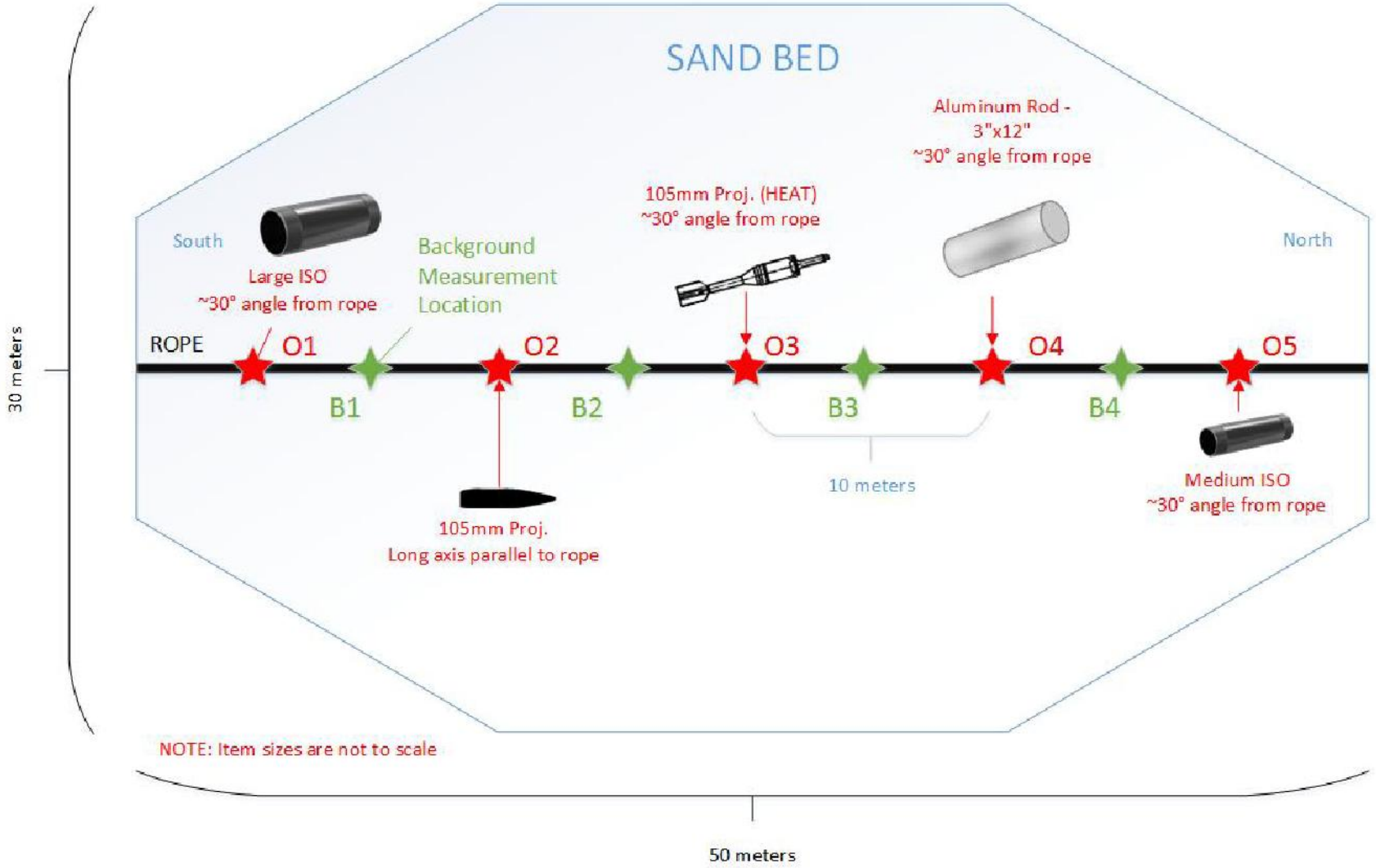

Figure 7. As-built diagram of test strip.

Object 1 (Large ISO) | Object 2 (105-mm Proj.) | Object 3 (105-mm Proj. HEAT) | Object 4 (Aluminum Rod) | Object 5 (Medium ISO)

Figure 8. Photographs of test objects prior to burial. (Intended burial depths and orientations relative to the centerline of the test strip were marked on the objects.)

Conductivity Measurements

After construction of the test strip, an Aqua Troll 200[3] was used to collect conductivity and other pond water parameter measurements directly above the burial locations of the objects, the results of which are shown in **Table 1**. The average values for actual conductivity and specific conductivity were 313 micro-siemens per centimeter (µS/cm) and 303 µS/cm, respectively. Typical seawater conductivity[4] is around 50,000 µS/cm and conductivity in most freshwater streams[5] is between 50 to 1500 µS/cm, thus the testing was performed in freshwater conditions.

[3] https://in-situ.com/products/water-level-monitoring/aqua-troll-200-data-logger/

[4] http://www.lenntech.com/applications/ultrapure/conductivity/water-conductivity.htm

[5] http://fosc.org/WQData/WQParameters.htm

Table 1. Pond water measurements

	OBJECT					
Parameter	**1**	**2**	**3**	**4**	**5**	**Average**
Temp (°C)	26.7	26.8	26.7	26.7	26.8	26.7
Pressure (PSI)	16.5	16.7	16.7	16.5	16.6	16.6
Depth (ft)	38	38.5	38.6	38.2	38.2	38.3
Actual Conductivity (µS/cm)	272.6	174.9	382.1	356.3	379.5	313.1
Specific Conductivity (µS/cm)	263.8	169.2	370.2	345.4	367.1	303.1
Resistivity (ohm-cm)	3668.7	5718.6	2617.1	2806.5	2635.1	3489.2
Salinity (PSU)	0.126	0.08	0.179	0.166	0.177	0.146
Total Dissolved Solids (ppt)	0.017	0.11	0.241	0.224	0.239	0.166
Water Density (g/cm^3)	0.997	0.997	0.997	0.997	0.997	0.997

NOTES
°C = degrees Celsius
PSI = pounds per square inch
ft = feet
µS/cm = microsiemen per centimeter
PSU = practical salinity unit
ppt = parts per thousand
g/cm^3 = grams per cubic centimeter

System Issue

Early in the data collection process it was determined that the signal was not being recorded properly for approximately 15% of the receiver cube channels from any particular measurement, but it was (for the most part) inconsistent which channels were affected. Troubleshooting in the field was not successful in identifying the cause of the issue, but the team determined that the data could still be used for classification. The electronics box was returned to Geometrics after completion of the pond testing and it was determined that the signal was being read in, but was extremely low and was not being recognized by the acquisition software. Further testing determined that the corrupt data were caused by incorrect delay values in the field-programmable gate array (FPGA) firmware that are affected by rising temperatures in the electronics canister, and this caused changes in the behavior of the serial lines on the analog-to-digital conversion hardware (specifically the FPGA Mezzanine Card [FMC] boards). The changes moved the converted digital signal partly out of the timing window during which the de-serialization hardware retrieves the data, resulting in mis-scaled or otherwise bad data. The host software controls the location of that hardware timing window by transmitting some FMC delays during startup and these delay values are determined empirically, during testing. Geometrics is in the process of determining the correct FMC delay values and their validity in varying thermal conditions, and developing tools to manage them during follow-up system work.

Sensor Function Test

A sensor function test was performed on the system after setup on October 11, 2016. The function test entailed measuring the response to a standard 4-inch diameter aluminum ball positioned above each of the receivers. **Figure 9** shows the aluminum ball above the array positioned over the A transmitter and B receiver (refer to **Figure 3** for transmitter and receiver nomenclature).

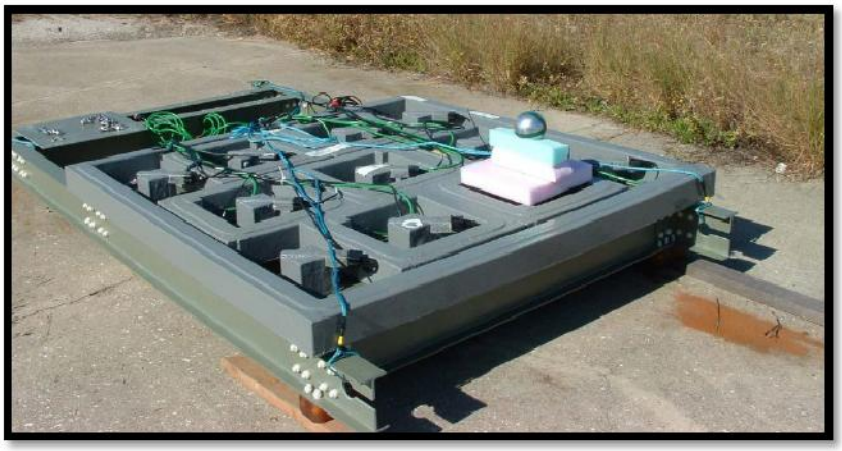

Figure 9. Aluminum ball over TxA/RxB during sensor function test.

Results for the sensor function test with the array on the deck (in air) on the first day are shown by **Figure 10.** Signal levels are in microTesla per Ampere-second (μT/As). Plot (a) (on the left) shows Z-axis responses for all of the monostatic transmit-receive TxRx pairs (the seven co-located transmitters and receivers). Negative signals are in red, positive in blue. All of the responses should be roughly identical. The odd blue curve is for the E receiver, which malfunctioned (see System Issue section above). The remaining six curves have a total spread in amplitude of ±2.8%. The middle plot (b) shows similar results for the ball over the corner receivers with the outer transmitter loop. By symmetry the responses should be identical. The observed spread was ±5.7%. The plot on the right (c) shows corresponding responses for the inner sets of receivers at the front and back of the array (B, C, I and J). Again, by symmetry they should have roughly identical responses. In this case the observed spread was ±2.9%. The sensor function test was not repeated with the array in the pond.

In-air and In-water Response Test

Identical in-air and in-water response measurements were made with the aluminum ball supported above the array on a PVC stand. The data were inverted using the UX-Analyze dipole fit algorithm and target locations calculated by inverting the in-air and in-water data were within 6 millimeters (mm) of each other. As shown by **Figure 11**, there was no discernable difference between the in-air and in-water polarizabilities; they were a near perfect match to each other based on the UX-Analyze classification algorithm. The PVC mounting broke after the first set of tests and the test was not repeated.

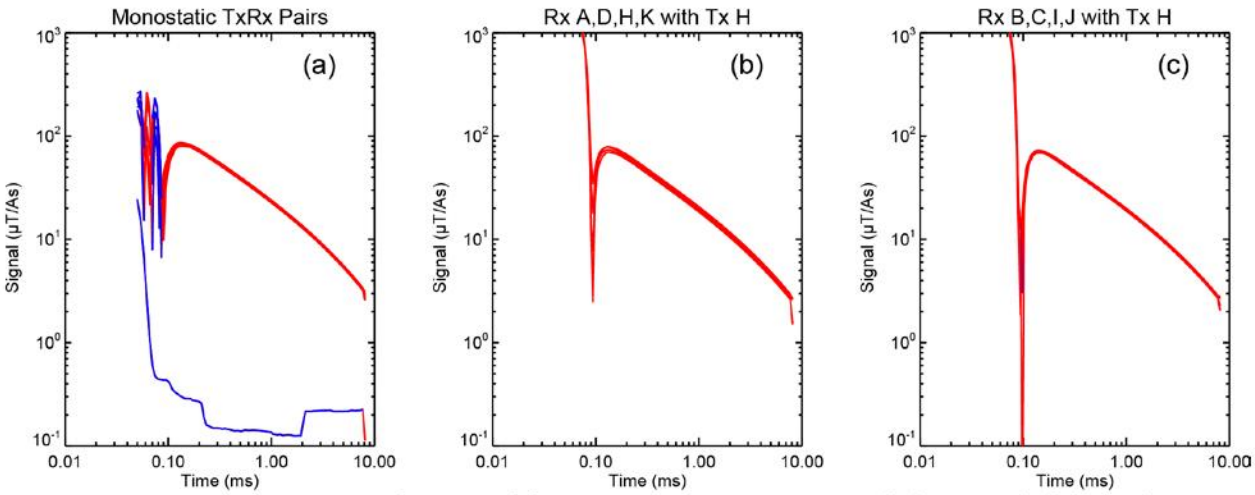

Figure 10. Sensor Function Test performance. (a) Measured Z-axis response to 4" aluminum ball for each monostatic TxRx pair. (b) Response for corner receivers with outer loop Tx. Response for inner front and back receivers with outer loop Tx.

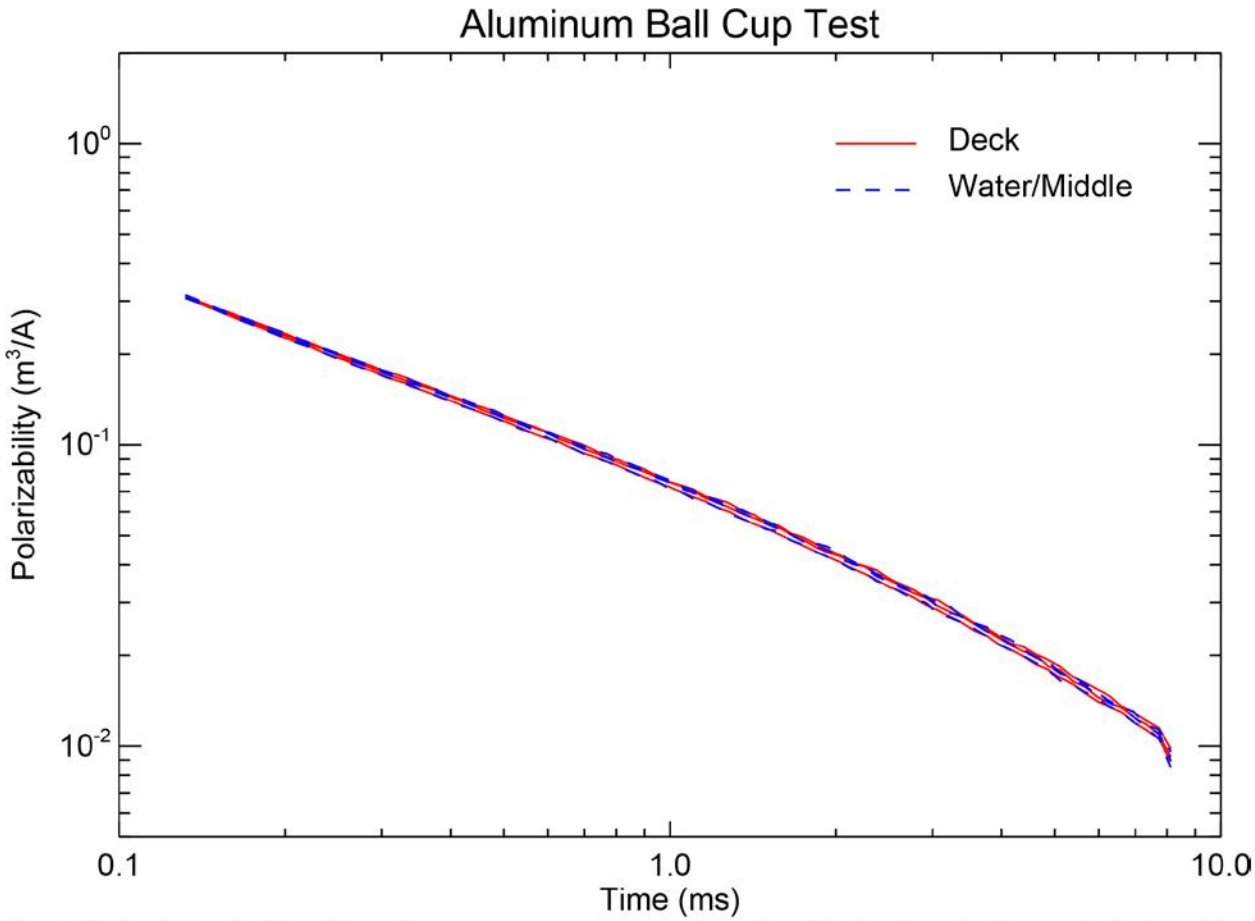

Figure 11. In-air (on deck) and in-water response measurements made with aluminum ball supported above the array on a PVC stand.

Background Response Test

Figure 12 shows the average background response for the monostatic TxC/RxG pair (Z-axis) at several locations. In the plot on the left (a) the array is in air on the deck. In the center plot (b) the array is on the bottom of the pond at background location B1 (see **Figure 7**), and on the right (**Figure 12c**) the array is in the pond at mid-depth (approximately 20 ft depth). Negative signals are plotted in red, positive in blue. In each plot the gray curves show the responses at the alternate locations for comparison. The monostatic background Z-axis responses are all similar, and are similar to background responses which have been observed with other TEM systems. Z-axis background responses with the outer loop transmitter (Ht) are similar to the monostatic background responses.

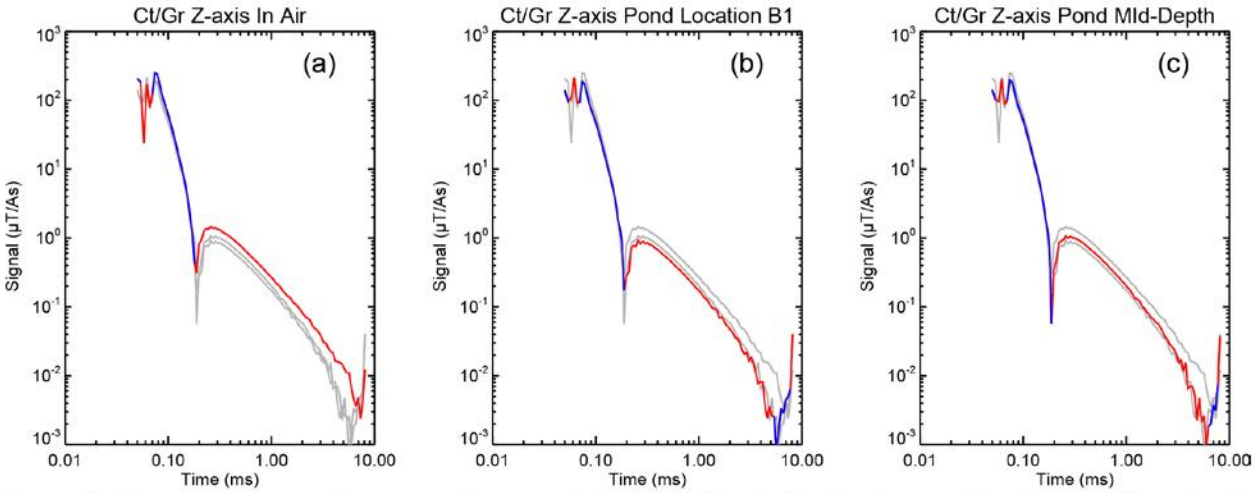

Figure 12. Average background response for monostatic TxC/RxG pair, Z-axis, at several locations. (a) Array in air on deck. (b) Array on the bottom of the pond at location B1. (c) Array in the pond at mid-depth. Negative signals in red, positive in blue. In each plot the gray curves show responses at the other locations for comparison.

Figure 13 compares the background responses for the different receiver axes (Z, Y and X for plots a, b and c respectively) using the monostatic TxC/RxG pair with the array in the pond at background location B1. As before, negative signals are plotted in red, positive in blue. In each plot the gray curves show the responses for the other receiver axes for comparison. Other Tx/Rx combinations (monostatic and bistatic) show similar X- and Y-axis responses. Bistatic Z-axis background responses are qualitatively different from monostatic Z axis responses. They are similar to the monostatic and bistatic X- and Y-axis responses.

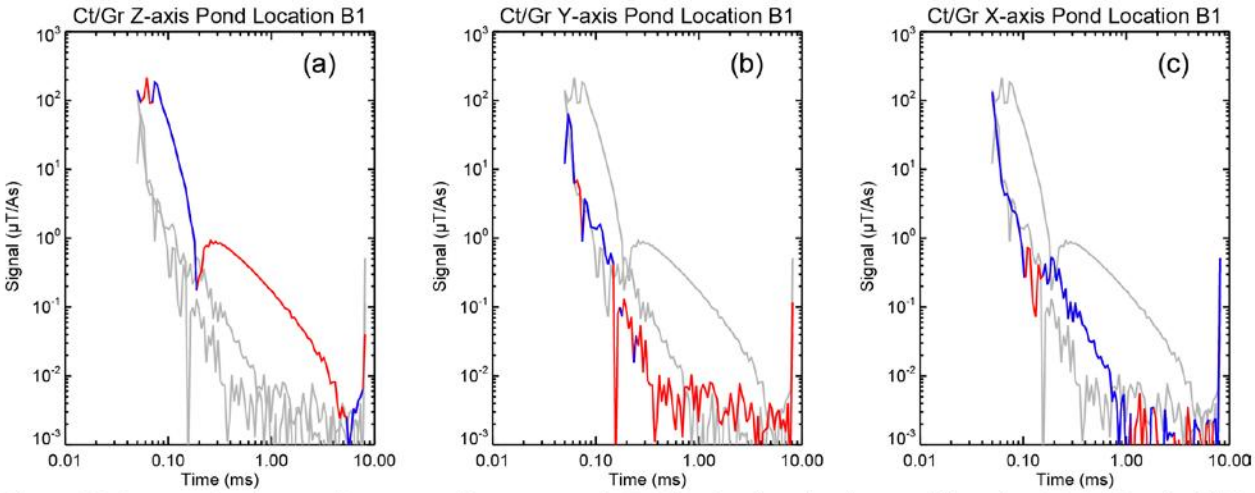

Figure 13. Average background response for monostatic TxC/RxG pair at background location B1. (a) Z-axis. (b) Y-axis. (c) X-axis. Negative signals in red, positive in blue. In each plot the gray curves show responses for the other axes for comparison.

Background response variability reflects the basic measurement noise for the array. **Figure 14** shows plots of the measurement-to-measurement background variability for the various transmit receive combinations with the array in the pond on the bottom at background location B1 (solid lines), suspended in the pond at mid depth (dashed lines) and in the air on deck beside the pond (chain dashed lines). The plots are arranged by row with monostatic combinations on the top, bistatic combinations in the middle and receivers paired with the outer transmit loop on the bottom, and by column with receiver Z-axis on the left, Y-axis in the middle and X-axis on the right. For each curve the root-mean-square (RMS) value was calculated for the measurement-to-measurement signal differences vs. decay time for each of the Tx/Rx pairs in the category. The plotted curve is the median of all of the RMS curves in the category (up to seven for monostatic combinations, seventy for bistatic combinations or eleven for outer loop combinations, depending on how many channels were operating properly). In **Figure 14** only measurements taken sequentially with the array stationary were used. The average time difference between measurements was 1½ minutes in all cases. The gray lines show the $t^{-1/2}$ decay expected for logarithmically gated uncorrelated Gaussian noise:

$$\sigma_G(t) = \sigma_W \sqrt{2\delta t / Nwt}.$$

Here $\sigma_G(t)$ is the gated RMS variability as a function of decay time t, σ_W is the sensor white noise level, δt is the sampling interval (0.004 ms), N is the number of repeats in each measurement (100) and w is the gate width (5%). The factor of two accounts for differencing the lobes of the bipolar transmit waveform. In all cases beyond about 0.1 ms the gated white noise is apparent. The corresponding sensor white noise levels calculated from the gated noise curves are listed in **Table 2**.

Table 2. Sensor white noise levels (μT/As) (calculated from curves in Figure 14)

Location	Pond Bottom B1			Pond Mid Depth			Deck		
Axis	Z	Y	X	Z	Y	X	Z	Y	X
Monostatic	1.162	1.290	1.216	1.046	1.162	1.258	1.264	1.316	1.128
Bistatic	1.152	1.186	1.194	1.022	1.164	1.102	1.116	1.194	1.178
Outer Loop	1.948	1.790	2.030	1.772	1.770	1.868	1.906	1.880	2.098

The average white noise level was 1.18 μT/As with the 40 cm transmit coils and 1.92 μT/As with the large outer loop[6].

[6] It should be noted that the outer loop noise only differs because the raw receiver signal is normalized by transmit current. The raw receiver noise levels are pretty much equal.

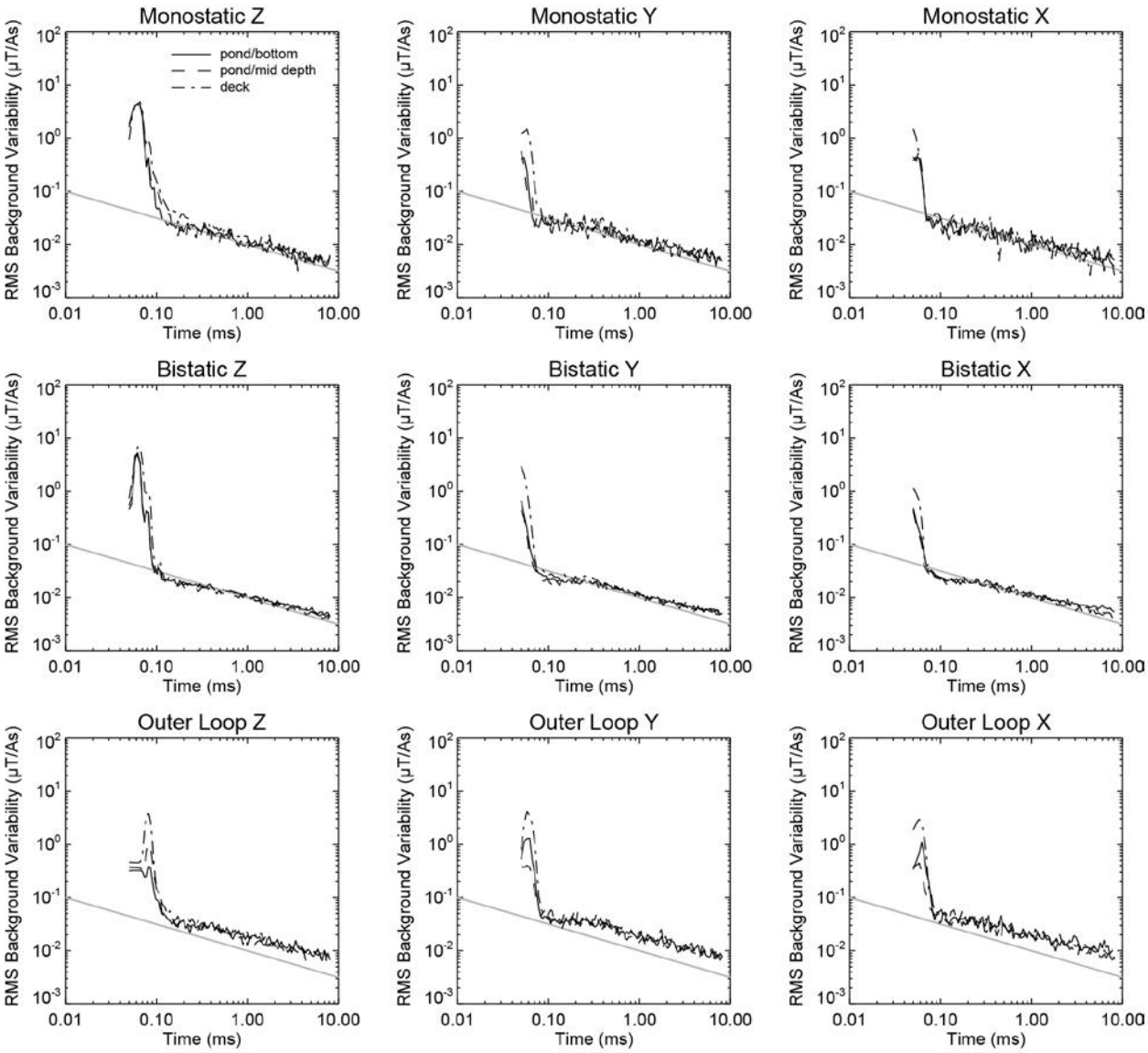

Figure 14. Median measurement-to-measurement background variability for various transmit/receive combinations. Top row, monostatic Tx/Rx pairs. Middle row, bistatic Tx/Rx pairs. Bottom row outer loop transmitter. Left column Z-axis receive, middle column Y-axis receive, right column X-axis receive. Solid curves are for successive measurements with the array on the bottom of the pond at background location B1. Dashed curves are for successive measurements with the array suspended in the pond at mid depth. Chain-dashed curves are for successive measurements with the array on deck beside the pond. The gray lines show the $t^{-1/2}$ decay expected for logarithmically gated white noise.

With longer time intervals and/or changes in the location of the array between measurements additional background variability is observed at early times, as illustrated in **Figure 15**. The layout of this figure is the same as **Figure 14**. Now the solid curves are for measurements as the array was moved from background locations B1 through B4 and back again. The average time interval between measurements was 37.7 minutes. The dashed curves are for measurements taken with the array suspended at mid depth with an average time interval between measurements of 14.9 minutes. A similar effect for successive measurements (average time interval 1½ minutes) is apparent with the array suspended at mid depth and held in position with rope by the divers. The chain dashed curves are for the array on deck with an average time interval between measurements of 18.4 minutes. The gray lines are the same as in **Figure 14**.

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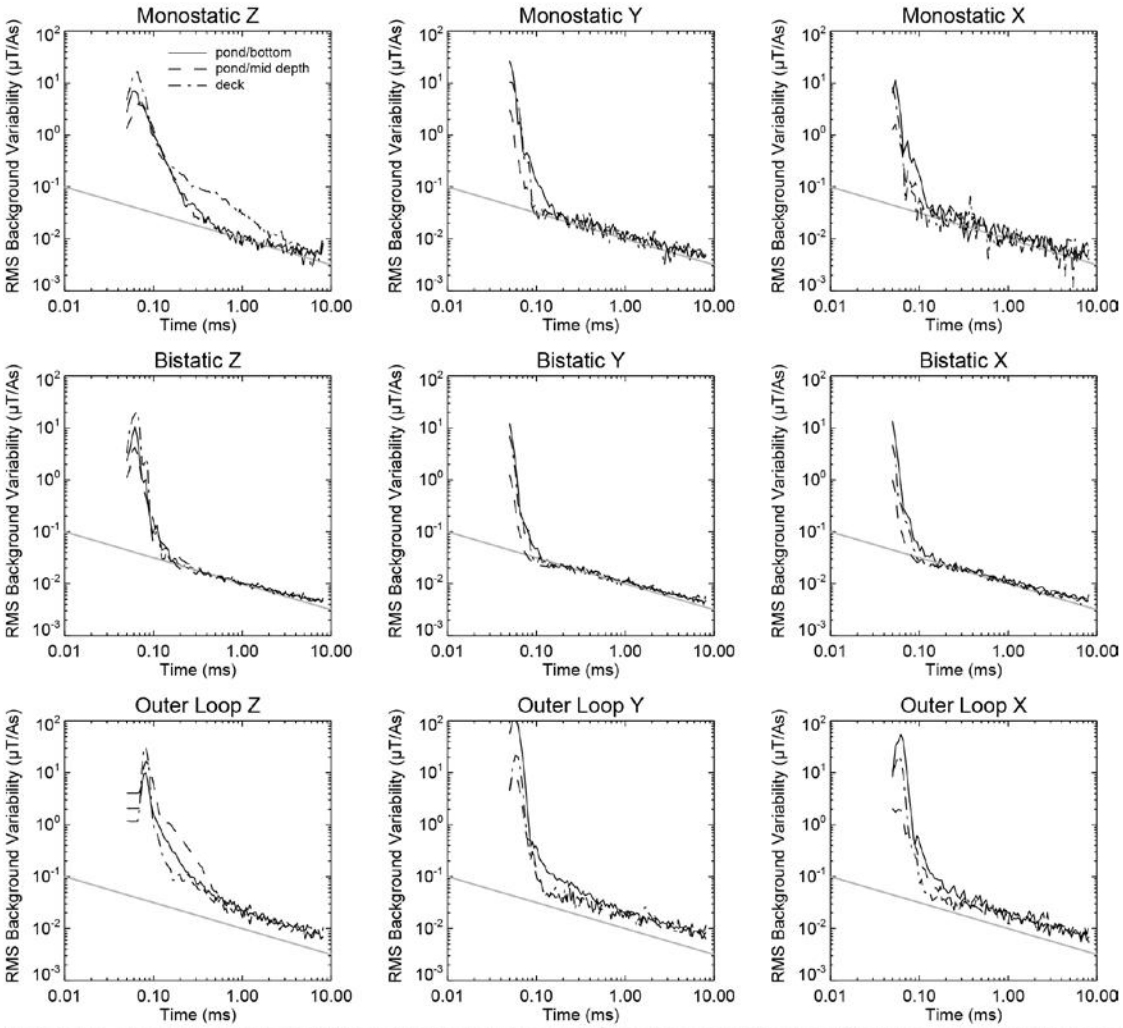

Figure 15. Background variability for various transmit/receive combinations for measurements spread out in time and/or space. Top row, monostatic Tx/Rx pairs. Middle row, bistatic Tx/Rx pairs. Bottom row outer loop transmitter. Left column Z-axis receive, middle column Y-axis receive, right column X-axis receive. Solid curves are for measurements with the array on the bottom of the pond at different background locations. Dashed curves are for measurements with the array suspended in the pond at mid depth with an average time between measurements of fifteen minutes. Chain-dashed curves are for measurements with the array on deck beside the pond with an average time between measurements of eighteen minutes. The gray lines show the $t^{-1/2}$ decay expected for logarithmically gated white noise.

Board Tests

The board tests were intended to check the accuracy of target locations and polarizabilities determined by inverting array data under controlled conditions. The basic UX-Analyze dipole inversion algorithm was used to fit the data. Malfunctioning data channels were not included and the first 18 time gates ($t < 0.132$ ms) were not used. The photograph on the left in **Figure 16** shows the test board mounted above the array. The board is a section of 6-inch I-beam with six sets of notches cut into the board for the targets. Medium and large ISO targets are shown resting in the notches. The drawing on the right shows dimensions of the board and its location relative to the array. The top of the test board was nominally 39.3 cm above the center of the array.

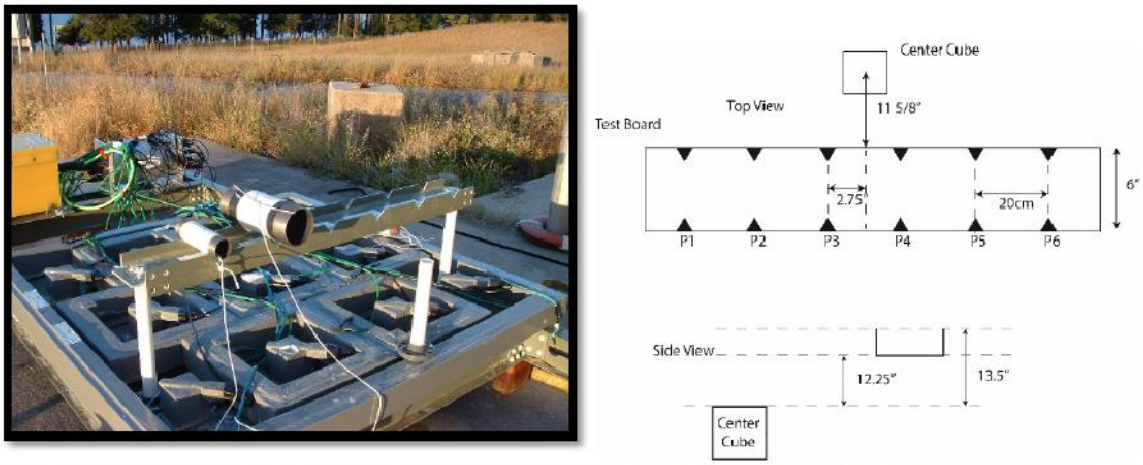

Figure 16. Left: Test board mounted above array, with medium and large ISO targets. Right: Drawing showing test board dimensions and location relative to array.

The board test was conducted with the array suspended at mid-depth (approximately 20 ft) in the pond. Three targets were tested: a medium ISO, a large ISO and a solid steel ellipsoid 6⅔ cm in diameter and 20 cm long. Each target was measured at each of the six notched locations on the board. The basic test procedure was to take a background measurement, measure the target at locations P1 through P3, then take another background followed by target measurements at locations P4 through P6, then a final background. **Figure 17** shows the board test results for the ellipsoid in the top row, the large ISO in the middle row and the medium ISO in the bottom row. The diagrams on the left compare dipole fit locations (◊) with nominal target locations (X). The diagrams in the middle compare dipole fit height above the center of the array with nominal target locations. The solid line is the top of the board and the dashed line shows the nominal distance to the center of the target resting on the board. The plots on the right compare calculated polarizabilities (solid curves) with library polarizabilities from ESTCP project MR-201424[7] for the large and medium ISO targets (dashed curves). The ellipsoid is not in the library.

[7] https://www.serdp-estcp.org/Program-Areas/Munitions-Response/Land/Enabling-Technologies/MR-201424

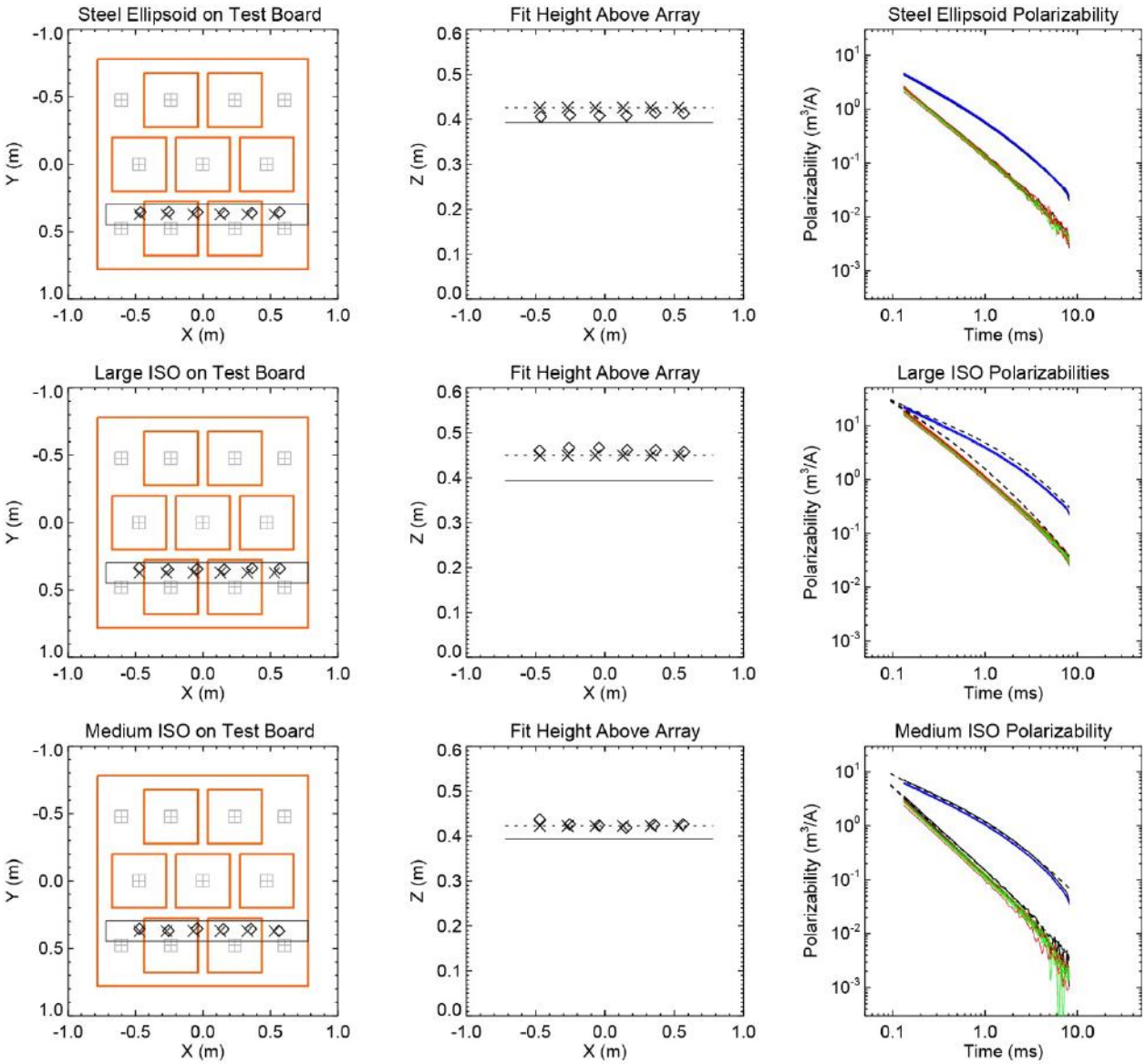

Figure 17. Board test results for the 6⅔ cm x 20 cm steel ellipsoid (top row), the large ISO (middle row) and the medium ISO (bottom row). The diagrams on the left compare dipole fit locations (◊) with nominal target locations (X). The diagrams in the middle compare dipole fit height above the center of the array with nominal target locations. The plots on the right compare calculated polarizabilities (solid curves) with library polarizabilities for the targets (dashed curves). The ellipsoid is not in the library.

Table 3 summarizes the results of the board tests. The dipole fit quality as determined by fit coherence (coh = squared correlation between data and dipole fit) was very good. Fit locations were generally within a few cm of the nominal target locations (Δxy, Δz). The ellipsoid dipole fit Z-locations are offset down a bit from the nominal Z-locations because the ellipsoid sits lower in the notches on the board than the ISOs. Classification metrics for matching to the library polarizabilities using the UX-Analyze classification algorithm are tabulated in the "library match" column. In all cases the polarizabilities determined by inverting the test board data are good matches to the library polarizabilities.

Table 3. Dipole fit parameters for targets on test board.

pos on board	Steel Ellipsoid				Large ISO				Medium ISO			
	Δxy (cm)	Δz (cm)	coh	library match	Δxy (cm)	Δz (cm)	coh	library match	Δxy (cm)	Δz (cm)	coh	library match
P1	1.9	-2.0	0.997	-	3.7	1.1	0.998	0.985	1.7	1.5	0.993	0.979
P2	2.6	-1.6	0.997	-	2.7	1.7	0.998	0.981	1.5	0.4	0.998	0.971
P2	3.4	-1.8	0.996	-	3.9	1.8	0.997	0.980	3.2	0.1	0.996	0.962
P4	2.7	-1.8	0.997	-	3.0	1.2	0.997	0.956	2.7	-0.4	0.998	0.932
P5	3.5	-1.2	0.997	-	4.9	1.2	0.998	0.981	3.0	0.3	0.987	0.987
P6	4.2	-1.3	0.997	-	5.1	0.8	0.998	0.984	3.4	0.4	0.956	0.956

Buried Target Measurements

As described previously, five targets were buried in the sand at the bottom of the pond and their locations are shown by **Figure 7**. Positions O1-O5 are target locations (large ISO, 105mm projectile, 105mm HEAT round, 4-inch x 12-inch aluminum rod, medium ISO) and B1-B4 are background locations where no objects were placed. During the first round of cued target measurements the array had 3-inch feet on it and it was positioned at each target location and moved[8] around over the nominal target locations for six different measurements (see **Table 4**). Background measurements were taken between each of the six-measurement target sequences at each of the five target locations.

For the second series of buried target measurements the 3-inch feet were switched out for 6-inch feet and three measurements (see **Table 4**) were subsequently performed at each target location with the array shifted slightly between measurements. The data were inverted using the UX-Analyze dipole fit algorithm. Malfunctioning data channels were not included, and the first 18 time gates ($t < 0.132$ ms) were not used. Several of the measurements on the large ISO required two-dipole fits, presumably because there were some metallic objects within the sand bed remaining from other operations conducted in the pond. The calculated polarizabilities were compared with polarizabilities from the ESTCP project MR-201424 library using the UX-Analyze classification algorithm and the results are summarized in **Table 4**. Anomalous early time signal behavior made it impossible to get good fits for the aluminum rod using single or multi-dipole models. This appears to be a problem with background removal rather than anomalous target signal content. Good fits were obtained using only late time ($t \geq 0.694$ ms) data. Observed signal variation with the aluminum rod relative to the apparent target locations based on late time data is not consistent with signal contributions from anomalous sources such as the electric field (current channeling) effects observed with aluminum targets in salt water in SERDP project MR-2409[9].

For the most part the measurements produced good fit quality and polarizabilities which were good matches to the library polarizabilities. The true target locations relative to the array are unknown; however, the board tests, discussed in the previous section, indicate an expected match of fit locations to within a few cm of the true target locations. To the extent that the fit locations reflect the actual target location, it appears that most of the time the array was positioned reasonably well over the target. With decent fit quality poor library matches typically occurred for targets outside the array footprint, as illustrated by **Figure 18**. The target locations in which the fit quality was okay but the match to the corresponding library item was less than 0.9, are circled on the figure. One of the medium ISO measurements (O5-6-1) did not converge to an acceptable fit using one or two dipole fit models and the library match failed; visual inspection of the data suggests that the array was not actually over the target and this is a bad

[8] The intent of moving the array between measurements was to compare classification with the object in various locations under the footprint of the array. The initial objective was to perform measurements in various locations within a single quadrant of the array but limited visibility in the pond resulted in a challenging environment within which the divers had difficulty precisely positioning the system.

[9] https://www.serdp-estcp.org/Program-Areas/Munitions-Response/Underwater-Environments/MR-2409

measurement. This measurement is represented by the red triangle at the center of the plot. Only two measurements (O1-3-1, O1-3-2) which fit to locations well outside the array footprint (near X = -0.4, Y = -1.2) had good (> 0.9) library matches. They are both measurements on the large ISO taken during the first sequence.

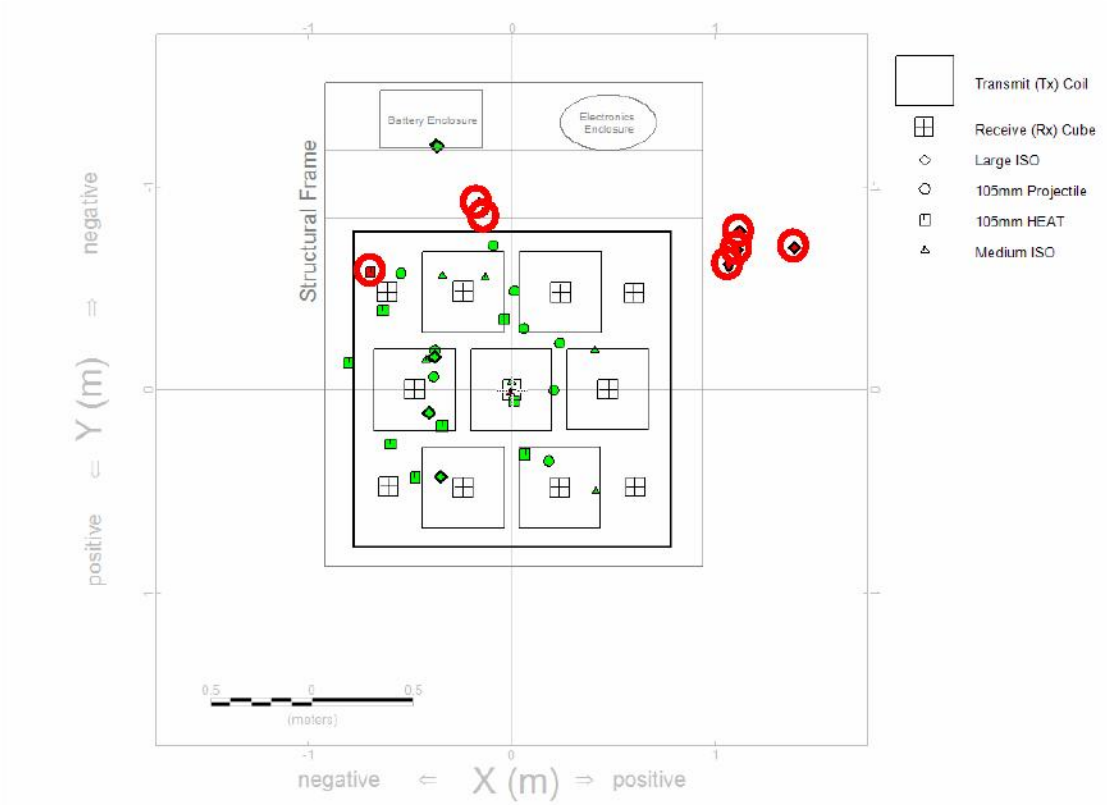

Figure 18. Buried target fit locations for ISOs and inert munitions. Green locations indicate >0.9 library match and red indicate <0.9. Circled locations indicate where the fit quality was good (>0.5) but the match to the corresponding library item was <0.9.

Table 4. Cued target fit parameters.

		Measurement with 3-inch feet						Measurement with 6-inch feet		
Large ISO (O1)	***Measurement ID:***	**O1-3-1**	**O1-3-2**	**O1-3-3**	**O1-3-4**	**O1-3-5**	**O1-3-6**	**O1-6-1**	**O1-6-2**	**O1-6-3**
	X (m)	-0.37	-0.37	*1.12*	*1.39*	*1.06*	*1.10*	-0.38	-0.41	-0.35
	Y (m)	*-1.21*	*-1.20*	-0.78	-0.70	-0.62	-0.69	-0.16	0.11	0.43
	Z (m)	0.39	0.38	0.30	0.12	0.33	0.29	0.45	0.44	0.41
	Fit Coherence	0.986	0.996	0.997	0.991	0.999	0.997	0.998	0.998	0.999
	Distance (m)	*1.26*	*1.26*	*1.36*	*1.56*	*1.23*	*1.30*	0.42	0.42	0.55
	Library Match	0.919	0.948	**0.861**	**0.630**	**0.866**	**0.816**	0.943	0.948	0.908
105mm Projectile (O2)	***Measurement ID:***	**O2-3-1**	**O2-3-2**	**O2-3-3**	**O2-3-4**	**O2-3-5**	**O2-3-6**	**O2-6-1**	**O2-6-2**	**O2-6-3**
	X (m)	-0.09	0.01	0.06	-0.39	-0.38	-0.55	0.24	0.21	0.18
	Y (m)	-0.71	-0.49	-0.30	-0.07	-0.20	-0.58	-0.23	0.00	0.35
	Z (m)	0.42	0.43	0.42	0.42	0.45	0.45	0.46	0.43	0.45
	Fit Coherence	0.999	0.996	0.989	0.993	0.991	0.998	0.992	0.992	0.997
	Distance (m)	0.72	0.49	0.31	0.39	0.43	0.79	0.33	0.21	0.39
	Library Match	0.957	0.969	0.993	0.952	0.970	0.964	0.997	0.943	0.971
105mm HEAT (O3)	***Measurement ID:***	**O3-3-1**	**O2-3-2**	**O2-3-3**	**O2-3-4**	**O2-3-5**	**O2-3-6**	**O2-6-1**	**O2-6-2**	**O2-6-3**
	X (m)	-0.60	-0.48	-0.34	*-0.80*	-0.63	-0.69	-0.04	0.01	0.07
	Y (m)	0.27	0.43	0.18	-0.13	-0.39	-0.58	-0.35	0.06	0.32
	Z (m)	0.41	0.39	0.43	0.42	0.44	0.46	0.51	0.48	0.50
	Fit Coherence	0.988	0.995	0.989	0.998	0.997	0.999	0.997	0.996	0.994
	Distance (m)	0.65	0.64	0.39	*0.81*	0.74	*0.90*	0.35	0.06	0.32
	Library Match	0.929	0.982	0.992	0.965	0.961	**0.697**	0.968	0.986	0.981
Aluminum Rod (O4)	***Measurement ID:***	**O4-3-1**	**O4-3-2**	**O4-3-3**	**O4-3-4**	**O4-3-5**	**O4-3-6**	**O4-6-1**	**O4-6-2**	**O4-6-3**
	X (m)	-0.02	0.08	0.29	-0.36	-0.53	-0.45	0.11	0.10	0.10
	Y (m)	-0.58	-0.30	0.16	0.08	0.17	-0.34	*-0.83*	-0.53	-0.10
	Z (m)	0.38	0.42	0.47	0.49	0.52	0.42	0.38	0.43	0.50
	Fit Coherence	0.997	0.995	0.990	0.997	0.996	0.995	0.991	0.997	0.994
	Distance (m)	0.58	0.31	0.33	0.36	0.55	0.56	*0.83*	0.54	0.14
	Library Match	-	-	-	-	-	-	-	-	-
Medium ISO (O5)	***Measurement ID:***	**O5-3-1**	**O5-3-2**	**O5-3-3**	**O5-3-4**	**O5-3-5**	**O5-3-6**	**O5-6-1**	**O5-6-2**	**O5-6-3**
	X (m)	-0.16	-0.13	0.00	-0.42	-0.34	-0.14	***[A]	0.41	0.42
	Y (m)	*-0.92*	-0.55	-0.04	-0.15	-0.57	*-0.88*	***	-0.20	0.50
	Z (m)	0.39	0.36	0.35	0.36	0.34	0.40	***	0.39	0.40
	Fit Coherence	0.990	0.999	0.996	0.998	0.980	0.653	***	0.988	0.992
	Distance (m)	*0.94*	0.57	0.04	0.45	0.66	*0.89*	***	0.45	0.65
	Library Match	**0.714**	0.968	0.917	0.938	0.957	**0.273**	***	0.936	0.937

Notes:

X, Y and distance values are relative to the center of the array and are *italicized and red* where greater than 0.8m.

Library match values below 0 9 are **bold and red**.

[A] Did not converge to acceptable fit. Review of the data suggests that this measurement was not collected over the object.

Performance Objectives

Results with respect to each of the performance objectives identified in the *Underwater Advanced Time-Domain Electromagnetic System Evaluation Plan* (CH2M, 2017) are discussed in the following sections and summarized in **Table 5**.

Objective: System is sufficiently waterproofed

The array remained underwater up to eight hours continuously and no leaks were discovered during field operations or indicated in the data collected.

Objective: Calibration method can be used both topside and underwater

Geometrics did not provide a baseline response plot in advance but a calibration test with an aluminum ball on a PVC pedestal was performed once on deck and once in the water. The pedestal broke after the initial measurements and could not be repeated, however, as shown by **Figure 11**, the results of the test showed an excellent match.

Objective: Classification can be achieved if item is anywhere within physical footprint of system

26 of 28 buried target measurements within the array footprint (initially considered as the entire 1.56 m x 1.56 m area within the outer coil) had a library classification match greater than 0.9. Visual inspection of the data for one of the two failures (medium ISO measurement O5-6-1) suggests that the target was not actually under the array. (An obvious lesson learned from this is that the individual performing the data collection must ensure that a response from a metallic object has been measured prior to moving to the next measurement location.) The remaining measurement that had a library classification match less than 0.9 was measurement O2-3-6 over the 105mm HEAT projectile, which had a match of 0.697. The projectile was within the footprint of the system but, as shown by the circled red square in **Figure 18**, it was at the outer edge (0.90m from the center) near a corner of the array. This result indicates that all objects will not necessarily be successfully classified if located within the footprint of the system if the footprint is considered the entire area within the outer coil. Until a revised footprint is determined, an alternative metric might be the distance of the object from the center of the array. **Figure 19** shows the relationship between the distance from the center of the array of each object (except the aluminum bar) when measured and its library match. Results indicate that all objects within 0.8m of the center of the array when measured were successfully classified (with the exception of medium ISO measurement O5-6-1 discussed earlier in this section.)

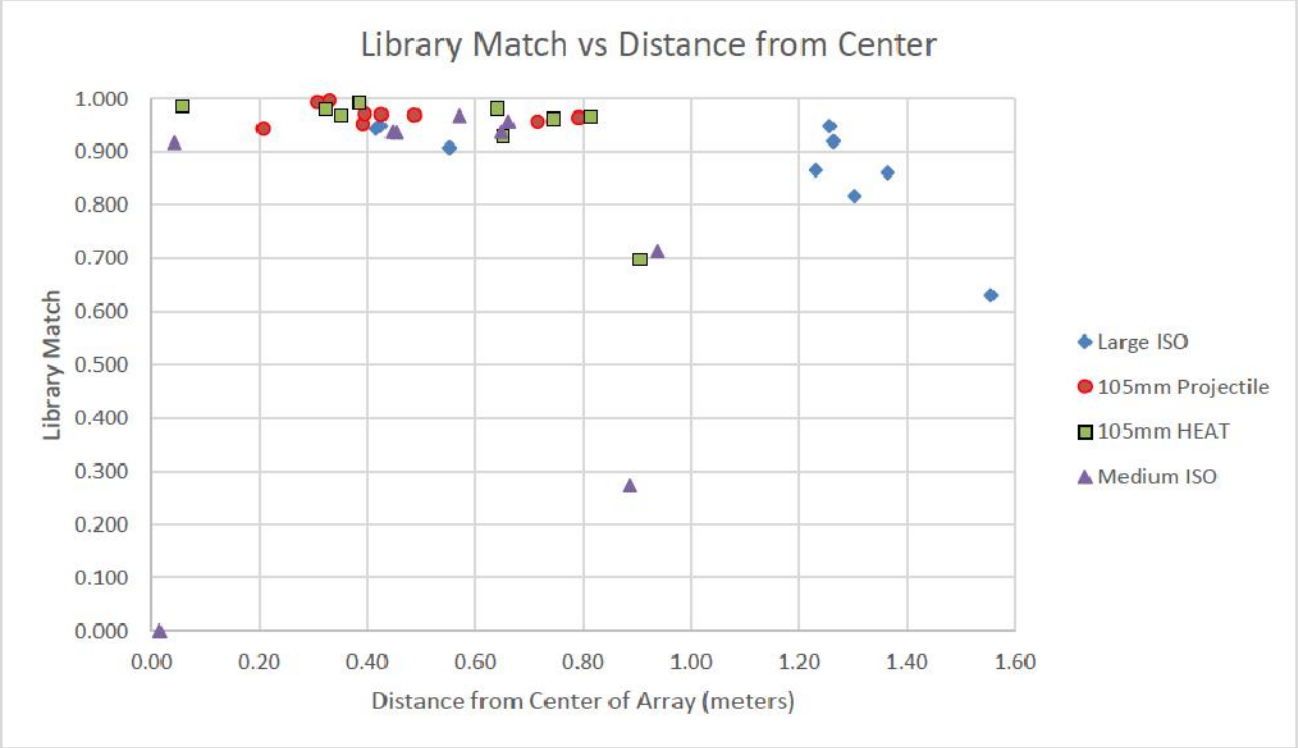

Figure 19. Graphs showing the relationship of the distance from the center of the array of each object during measurement to the library match.

Objective: Sensor response repeatability (cued surveys)

The intent of this objective was to record the response from a standard object at the same distance and orientation on a daily basis. As discussed previously, an aluminum ball on a PVC pedestal was to be used for this test but the pedestal broke after the initial day's measurements and was not repeated on the second day. However, multiple measurements over the same object at similar distances from the center of the array show good repeatability in terms of the library match. During the next phase of system evaluation, the sensor response repeatability will be further confirmed.

Objective: Sensor can be deployed using winch and donut approach

The array was easily deployed into the pond using the crane and maneuvered in the water using the inner-tube shallow water lift system (donut) and winch. The divers provided some feedback with respect to modifications, such as handles on the frame, holes in the base of the system for visibility to the bottom, cable management, and improvements to the attachment mechanism for the ropes used to deploy the system with the crane and winch.

Prior to the next deployment the team will attach handles, ensure that the harnesses cannot slip off of the system while being deployed, and a sleeve will be added around all cables to keep them together.

Objective: Sensor can be sufficiently maneuvered in underwater environment by divers such that the divers' safety is not compromised

Feedback from the divers indicated that there were no safety issues related to maneuvering the system underwater.

Objective: Sensor can be sufficiently maneuvered in underwater environment by divers such that the system can be placed satisfactorily on the desired cue location to collect classification data

The system was easily transported between measurement points in less than 10 minutes; however, as discussed previously, some improvements to the system would make it even easier to transport and effectively position the system over the intended target location. The divers had difficulty ensuring that the target location was under the array footprint in 9 out of the 45 measurements. While 3 of these were within 15 cm of the edge of the array, 6 were between 28 and 60 cm away; all 6 of these were measurements of the large ISO (O1-3-1 through O1-3-6), so clearly there was either an issue with movement of the rope marking the object location or some other factor specific to this set of measurements. (In other words, the inaccuracy may be related to the marking approach used as opposed to the divers' ability to maneuver and place the system.)

A Diver Proximity Test was performed near the end of the field operations to determine whether the procedure employed over the course of the testing of the divers moving 10-20 feet away from the system during measurements was necessary. For this test a measurement was collected at a background location with the divers away from the system and two separate measurements with a diver standing at the edge of the system where the battery and electronics boxes are located. **Figure 20** shows an overlay of the results, which indicates that the presence of the divers had little or no effect and that the time between measurements can be further reduced as the divers do not need to go as far away from the system as they did during the field evaluation.

During the next deployment the team will also employ additional markers and ropes on the sediment surface to assist the divers with appropriate reacquisition of the system for data measurements.

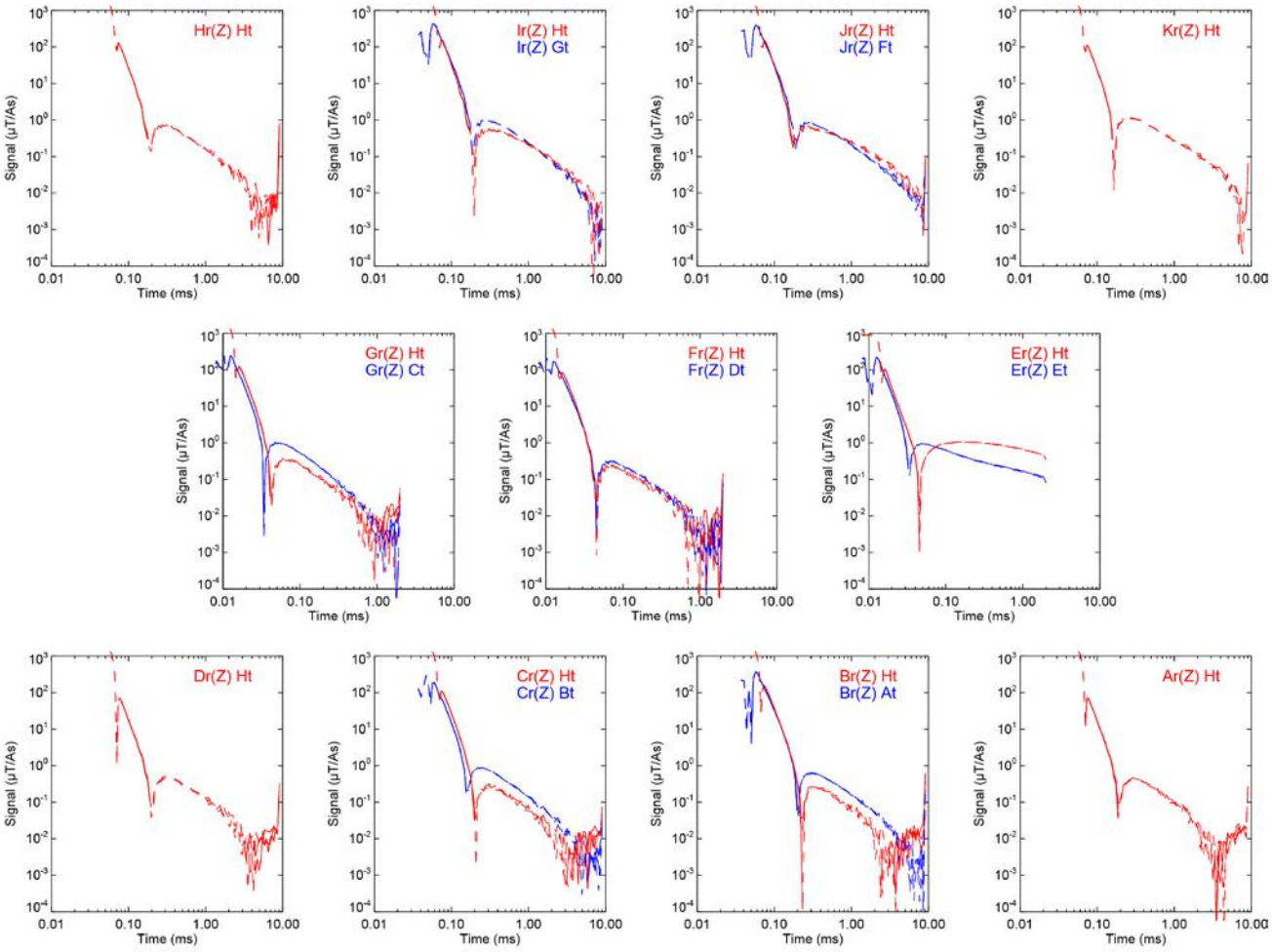

Figure 20. Overlay of monostatic Z-axis responses (blue) and Z-axis responses with outer (H) transmitter (red) for no diver and two measurements with a diver standing by the battery box. Solid portions are positive signal, dashed portions are when signal is negative.

Objective: Inversion results support classification

The Fit Coherence was greater than 0.8 for 43 of 45 cued measurements (see **Table 3**). One of the failures, medium ISO measurement O5-3-6, fit to a location 9 cm outside of the array footprint and 0.89 m from the center of the array. For the other failure, medium ISO measurement O5-6-1 discussed in previous sections, the dipole inversion failed and visual inspection of the data suggests that the array was not actually over the target.

Objective: Inversion result provides correct position

Fit locations were generally within a few cm of the nominal target locations for the board tests (see **Figure 9**, **Table 2**), with an average of 3.2 cm and a maximum of 5.1 cm. Exact locations relative to the array were not known for the buried target measurements.

Objective: Classification is valid

28 of 36 buried target measurements had a UX-Analyze classification metric greater than 0.9. All but one of the failures were outside of or near the edge of the array footprint. The other one was medium ISO measurement O5-6-1 (discussed in previous sections) which had a poor fit quality (0.264) and for which the library match failed; visual inspection of the data suggests that the array was not actually over the target.

Table 5. Performance Objectives and Results				
Performance Objective	**Metric**	**Data Required**	**Minimum Acceptable Criteria**	**Result**
System is sufficiently waterproofed	No indications that water has leaked into system components	Data collected by system and visual observation	Data do not indicate water has entered system components.	No indications that water leaked into system components
Calibration method can be used both topside and underwater	Baseline response plots provided by Geometrics are similar to response in water and on land	Data collected by system and visual observation	Response plots of system are reasonably similar to baseline plots – qualitative measurement	Geometrics did not provide a baseline response plot in advance but a calibration test with an aluminum ball on a PVC pedestal was performed once on deck and once in the water. The pedestal broke after the initial measurements and could not be repeated, however, the results of the test showed an excellent match.
Classification can be achieved if item is anywhere within physical footprint of system	If classification is possible at a location under the physical footprint of the array it is possible at all other locations under the footprint as well	Response curve of metallic object placed at multiple locations under footprint, to include edges	If classification is possible at a single location under the physical footprint of the array it is possible at all other locations under the footprint as well	26 of 28 buried target measurements within the array footprint had a library classification match > 0.9. Visual inspection of the data for one of the 2 failures (medium ISO measurement O5-6-1) suggests that the target was not actually under the array. The remaining target (105mm HEAT measurement O3-3-6) that had a library classification match <0.9 had a match of 0.697. The projectile was within the footprint of the system but was at the outer edge (0.90m from the center) near a corner of the array. This result indicates that all objects will not necessarily be successfully classified if located within the footprint of the system. All objects within 0.8m of the center of the array when measured were successfully classified (with the exception of the erroneous medium ISO measurement and the aluminum bar.)
Sensor response repeatability (cued surveys)	Standard response to a known target in a known location	Amplitudes from daily testing over standard item at same distance and orientation	≤ 20% Root-Mean-Squared (RMS) variation in amplitude	An aluminum ball on a PVC pedestal was to be used for this test but the pedestal broke after the initial day's measurements and was not repeated on the second day. However, multiple measurements over the same object at similar distances from the center of the array show good repeatability in terms of the library match.

Table 5. Performance Objectives and Results				
Performance Objective	**Metric**	**Data Required**	**Minimum Acceptable Criteria**	**Result**
Sensor can be deployed using winch and donut approach	System can be deployed using winch without compromising safety of test personnel, integrity of the system, or property damage	Visual observation of system and deployment components	Test personnel are not in danger of being injured and the system or property are not in danger of being damaged	The array was easily deployed into the pond using the crane and maneuvered in the water using the donut and winch.
Sensor can be sufficiently maneuvered in underwater environment by divers such that the divers' safety is not compromised	Divers are comfortable that their safety will not be compromised maneuvering the system	Verbal feedback from divers	Divers indicate they are comfortable that their safety is not compromised	Feedback from the divers indicated that there were no safety issues related to maneuvering the system underwater.
Sensor can be sufficiently maneuvered in underwater environment by divers such that the system can be placed satisfactorily on the desired cue location to collect classification data	Divers are able to effectively and efficiently maneuver the system to the desired cue location	Verbal feedback from divers Time to move system between cue locations	Divers indicate they are able to effectively and efficiently maneuver the system to the desired cue location. Time required to move system between cue locations is less than 10 minutes	The system was easily transported between measurement points in less than 10 minutes; however. The divers had difficulty ensuring that the target location was under the array footprint in 9 out of the 45 measurements. While 3 of these were within 15 cm of the edge of the array, 6 were between 28 and 60 cm away; all 6 of these were measurements of the large ISO (O1-3-1 through O1-3-6), so clearly there was either an issue with movement of the rope marking the object location or some other factor specific to this set of measurements. (In other words, the inaccuracy may be related to the marking approach used as opposed to the divers' ability to maneuver and place the system.)
Inversion results support classification	Modeled response match observed responses	Fit coherence from inversion	0.8 (using UX-Analyze fit coherence calculation)	The Fit Coherence was greater than 0.8 for 43 of 45 cued measurements. One of the failures, medium ISO measurement O5-3-6, fit to a location 9 cm outside of the array footprint and 0.89 m from the center of the array. For the other failure (medium ISO measurement O5-6-1) the dipole fit did not properly converge and visual inspection of the data suggests that the array was not actually over the target.

Table 5. Performance Objectives and Results				
Performance Objective	**Metric**	**Data Required**	**Minimum Acceptable Criteria**	**Result**
Inversion result provides correct position	Derived target positions match independent measured positions	Independent measurement of target in known position and inversion results	Offset < 40cm	Fit locations were generally within a few cm (average of 3.1cm, maximum of 5.1cm) of the nominal target locations for the board tests.
Classification is valid	Target polarizabilities for known items match library responses	Dipole inversion parameter values and polarizabilities for known, isolated targets (ISO's)	<25% difference between calculated and library reference polarizabilities UX-Analyze classification metric >0.9 (library match correlation)	28 of 36 buried target measurements had a classification metric >0.9. All but one of the failures were outside of or near the edge of the array footprint. The other one was medium ISO measurement O5-6-1 for which the dipole fit did not converge properly and for which the library match failed; visual inspection of the data suggests that the array was not actually over the target.

Summary and Path Forward

CH2M performed a system evaluation of the Underwater Advanced Time-Domain Electromagnetic System at NSWCPCD's freshwater pond facility in October 2016. With minor exceptions, the performance objectives were achieved and the system was demonstrated effective in collecting data used for the classification of munitions in a freshwater environment. The path forward, upon approval by ESTCP, is to prepare for and perform a saltwater evaluation of the full system. The following modifications will be made to the system prior to redeployment:

1. Handles will be attached to make the system more easily maneuverable for the divers
2. The attachment point for the ropes will be modified such that the ropes cannot slip off of the system while being deployed
3. A sleeve will be added around all cables to keep them together

Defense Office of Prepublication & Security Review

Case Number: 17-S-2246/0 **Source:** AT&L - Herbert Nelson

Subject: Updating the Marine Towed Array for Advanced Geophysical Classification

Purpose: PUBLIC RELEASE **Event Date:** **Pages:** 23

Requester: Steinhurst, Dan **Document Type:** SLIDES

Date Received: 08/07/2017 **Classification:** Unclassified **Typist:** DKLUZIK

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Reviewer's Worksheet: **Action Officer:** DKLUZIK

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OASD EI&E	08/08/2017	08/14/2017	NO OBJ	Requestor, 15-AUG-2017

Notes:

Comments: (continue on reverse side if necessary)

OSR Action

Recommended Action

- ☐ **Cleared**
- ☐ **Cleared as Amended**
- ☑ **Not Cleared**
- ☐ **See Memo Attached**

Initials/Date PK 8/15/17

Final Action

- ☐ **Cleared**
- ☐ **Cleared as Amended**
- ☑ **Not Cleared**
- ☐ **See Memo Attached**

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Case should be indexed under the following keywords:

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Kluzik, Donald E CIV WHS ESD (US)

From: Kluzik, Donald E CIV WHS ESD (US)
Sent: Wednesday, August 16, 2017 10:41 AM
To: (b)(6) @mail.mil'
Subject: Security Review response 2246 (UNCLASSIFIED)
Attachments: 2246.pdf
Signed By: donald.e.kluzik.civ@mail.mil

Tracking:

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Hello,

Attached is the DOPSR response for security review case 17-S-2246.

I will be out of the office from August 17 through September 17. Please contact Ken Hanes, 703-614-4927, Kenneth.l.hanes.civ@mail.mil, if you have any questions about this case. Thank you.

Don Kluzik
Defense Office of Prepublication and Security Review
2A534
703-614-4931

Comments - https://ice.disa.mil/index.cfm?fsa=card&sp=139133&s=110&dep=*DoD

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DEPARTMENT OF DEFENSE
DEFENSE OFFICE OF PREPUBLICATION AND SECURITY REVIEW
1155 DEFENSE PENTAGON
WASHINGTON,DC 20301-1155

August 15, 2017
Ref: 17-S-2246

MEMORANDUM FOR: THE UNDER SECRETARY OF DEFENSE ACQUISITION, TECHNOLOGY, AND LOGISTICS
OFFICE OF ASSISTANT SECRETARY OF DEFENSE FOR ENERGY, INSTALLATIONS, AND ENVIRONMENT
STRATEGIC ENVIRONMENTAL RESEARCH AND DEVELOPMENT PROGRAM
(ATTN: (b)(6) [redacted])

SUBJECT: Security Review Request – "Updating the Marine Towed Array for Advanced Geophysical Classification"

This office has reviewed the attached subject presentation with accompanying Form DD1910 and it is **NOT APPROVED** for public release. It has been determined that the presentation describes technical research that may be applicable to future anti-submarine and mine warfare.

Mark the presentation as "DISTRIBUTION STATEMENT D. Distribution authorized to the Department of Defense and U.S. DoD contractors only; Critical Technology; 15 August 2017. Other requests shall to be referred to AT&L".

This decision may be administratively appealed. Any such appeal should offer justification to support reversal of the decision and should be forwarded to this office. Please direct any questions regarding this case to Mr. Donald Kluzik at 703-614-4931, email: donald.e.kluzik.civ@mail.mil.

for Darrell W. Walker
Chief

Attachments:
As stated

18-L-0334/DOPSR/0105

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TO: Director, Freedom of Information & Security Review, Rm. 2C757, Pentagon

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NO SCRIPT PROVIDED

6. REMARKS

THE INFORMATION CONTAINED IN THIS REPORT FALLS UNDER THE PURVIEW OF THIS OFFICE.

WHEN CLEARED, PLEASE EMAIL DD-1910 to (b)(6)@mail.mil

if mailed: (b)(6), 4800 Mark Center Drive Suite 17D03, Alexandria, VA 22350-3605

7. RECOMMENDATION OF SUBMITTING OFFICE/AGENCY

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Strategic Environmental Research and Development Program

b. CLEARANCE IS REQUESTED BY 20170814 *(YYYYMMDD).*

c. NAME *(Last, First, Middle Initial)*	d. TITLE
Nelson, Herbert	Acting Executive Director
e. OFFICE: OASD(EI&E)	f. AGENCY: AT&L
g. SIGNATURE	h. DATE SIGNED *(YYYYMMDD)*: 20170807

DD FORM 1910, MAR 1998 (EG) PREVIOUS EDITION MAY BE USED. WHS/DIOR, Mar 98

18-L-0334/DOPSR/0106
17-S-2246

Updating the Marine Towed Array for Advanced Geophysical Classification

SLIDES ONLY
NO SCRIPT PROVIDED

Dr. Dan Steinhurst
Nova Research, Inc.

SERDP DOD • EPA • DOE

ESTCP

18-L-0334/DOPSR/0107
17-S-2246

Agenda

- Project motivation
- Marine Towed Array
- Sensors for unexploded ordnance (UXO) classification
- Array design and testing
- Modeling results
- Conclusions

18-L-0334/DOPSR/0108

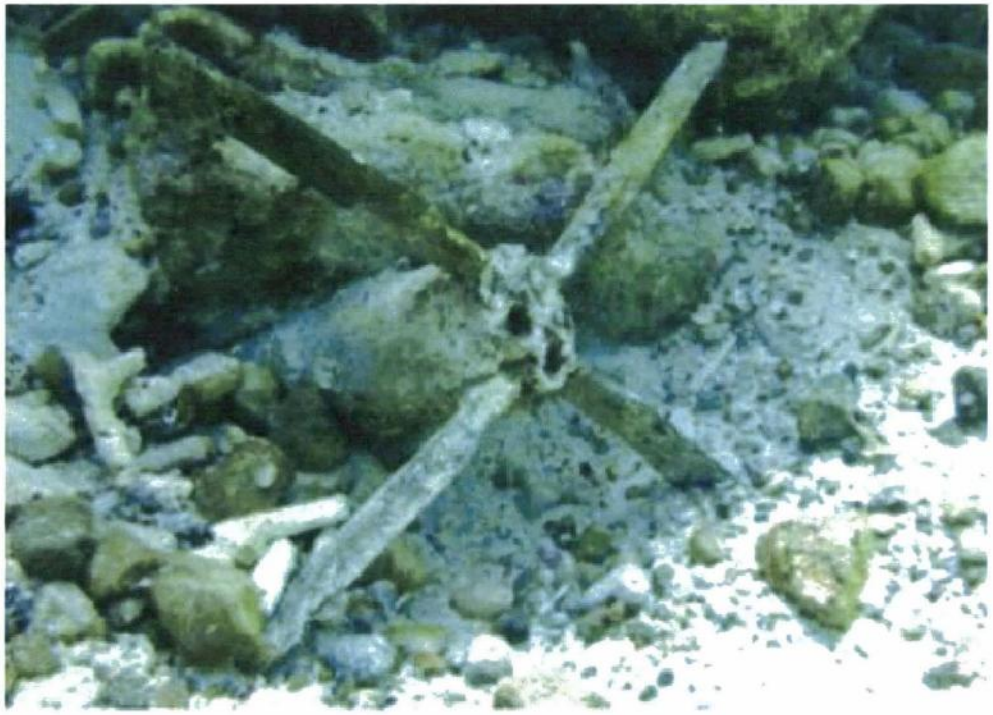
Project Motivation

- UXO
  - Large number of underwater sites
  - Present a significant human health risk
- Systematic detection and classification limited
  - Unfriendly survey conditions
  - Technology gaps, as compared to land surveys
- Acoustic systems
  - Significant standoff range
  - Limited capability against buried targets
  - Limited capability in shallow water (3-5 m)
- Adaptation of land-based UXO technology

18-L-0334/DOPSR/0109

UXO in the Underwater Environment

Photo: ESTCP MR-0324 - Bahia Salinas del Sur Final Report



18-L-0334/DOPSR/0110

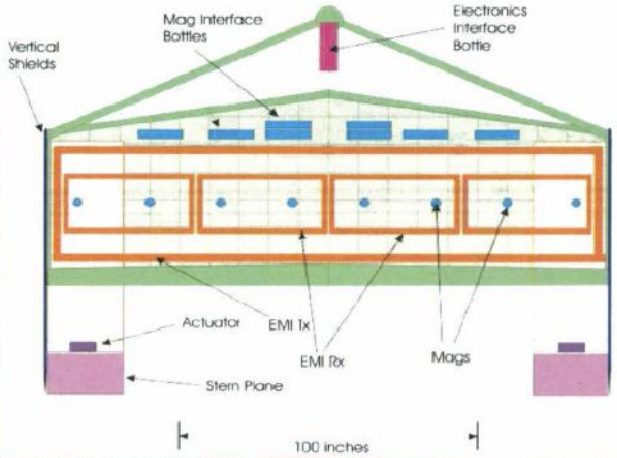
Marine Towed Array

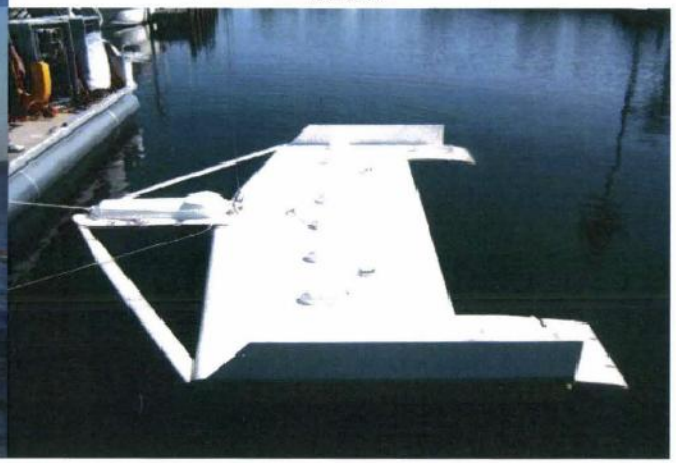
- Towed "Flying Wing" design
  - Development funded by SERDP/ESTCP
  - Dual-mode sensor array
    - Total-field Cesium-vapor magnetometers
    - Electromagnetic induction (EMI) sensor array
- Successfully demonstrated under a range of conditions
- 75 lane-km per day coverage with magnetometers

18-L-0334/DOPSR/0111

Marine Towed Array

Photos: ESTCP MR-0324 Reports





18-L-0334/DOPSR/0112

Sensors for UXO Classification

- Total-field magnetometry
  - Provides effective size and position
  - Little classification ability
- EMI
  - Advanced systems capable of determining
    - Position, depth, size, wall thickness, and shape
  - Robustly support UXO/clutter classification
  - Success demonstrated for land applications

18-L-0334/DOPSR/0113

Capability of Advanced Geophysical Classification

Photos: NRL, for ITRC GCMR-1 Fact Sheet

Munition

Suspected Munition

Munition Fragment

Debris

18-L-0334/DOPSR/0114

Advanced Geophysical Classification (AGC) Sensor Systems

Photos: ESTCP, URS, USACoE

18-L-0334/DOPSR/0115

EMI Array Upgrade

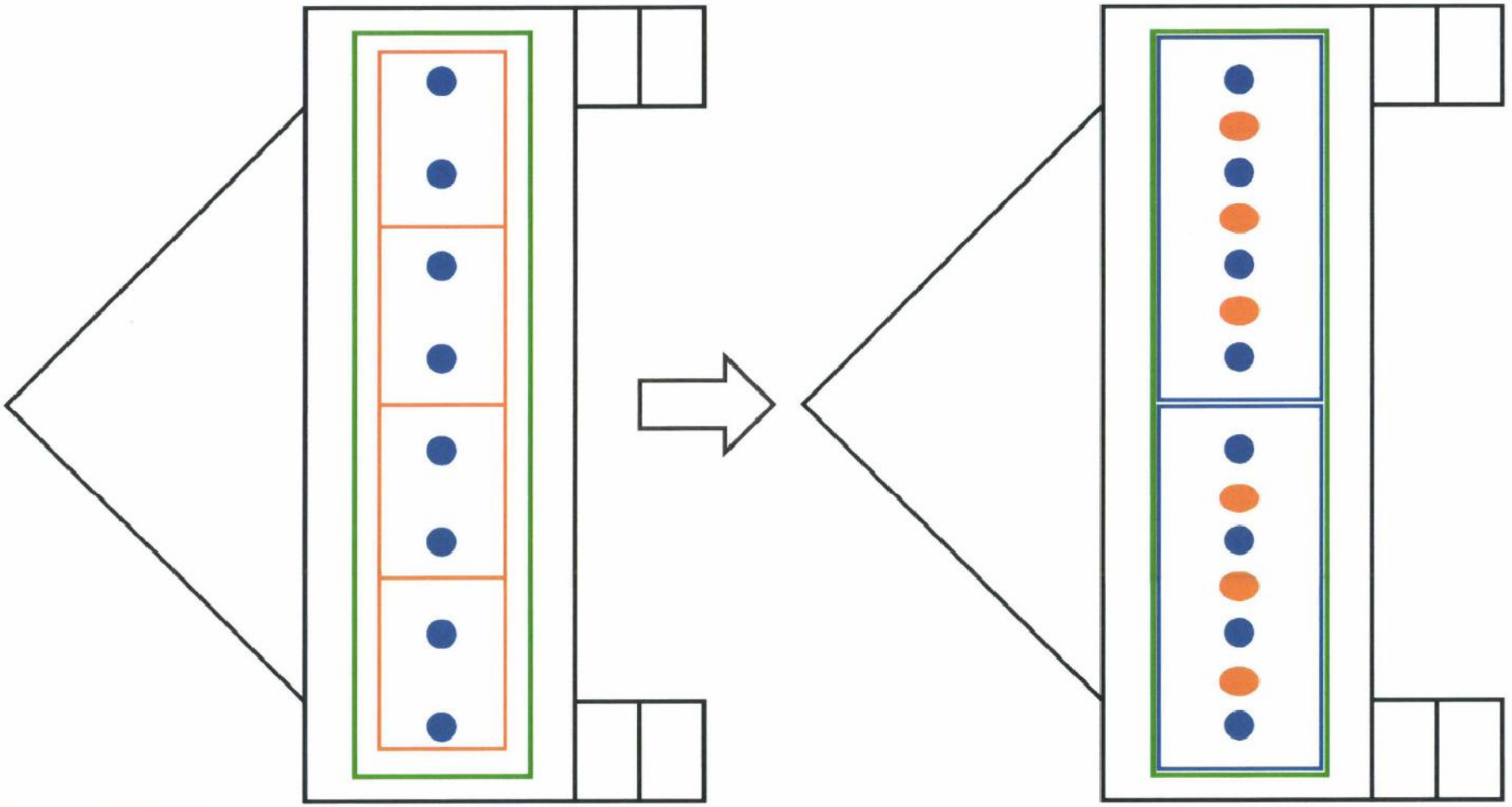
- Original array
  - Detection-only electronics
  - Low resolution
    - Four 0.5m x 1.0m receiver coils
  - Mechanical and electrical issues
- Updated design
  - AGC-level electronics
  - Multi-static data collection

18-L-0334/DOPSR/0116

EMI Array Schematic

Original Configuration

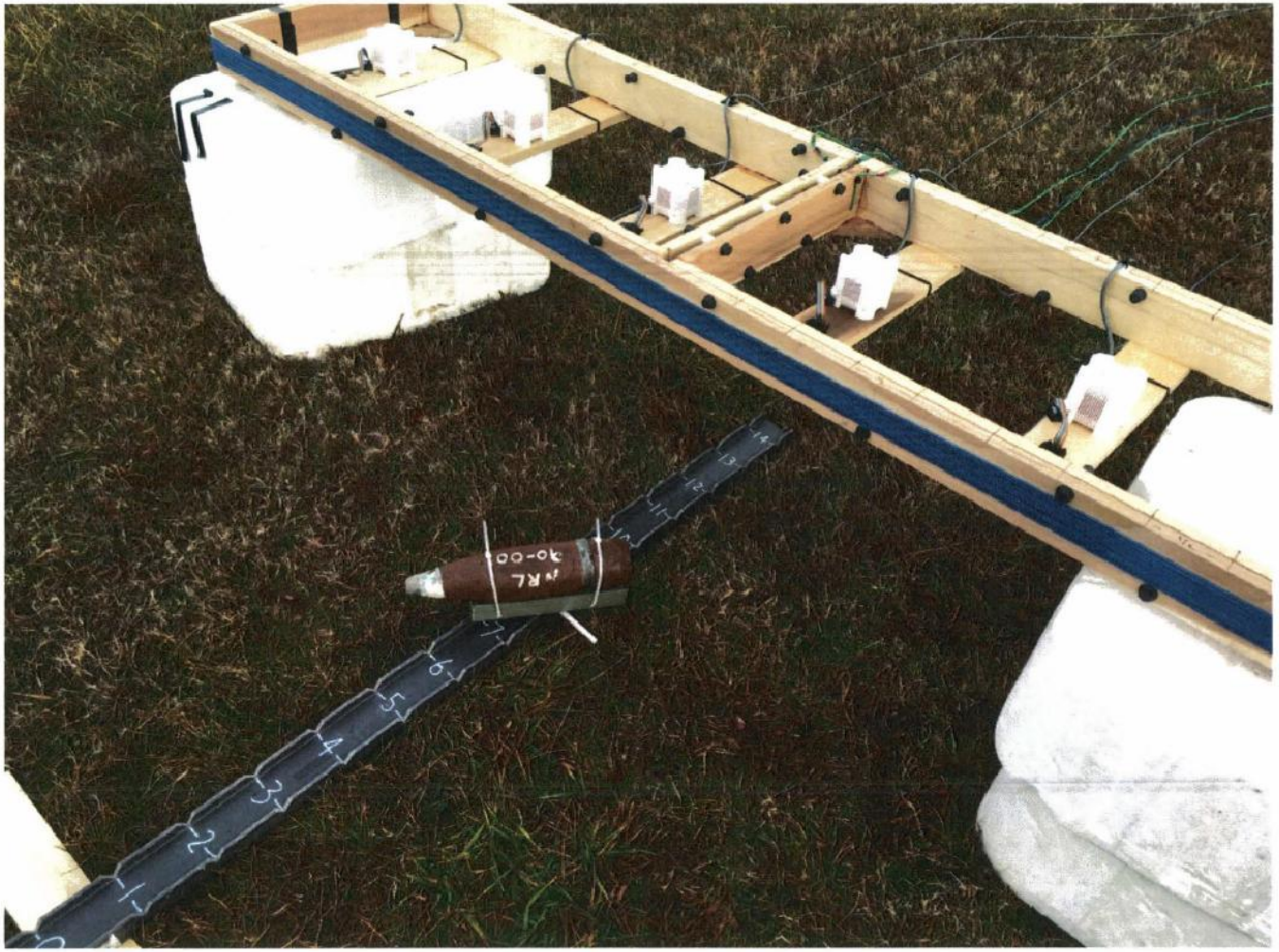
Proposed Configuration



18-L-0334/DOPSR/0117

Mini Marine Towed Array – Half-Scale Model

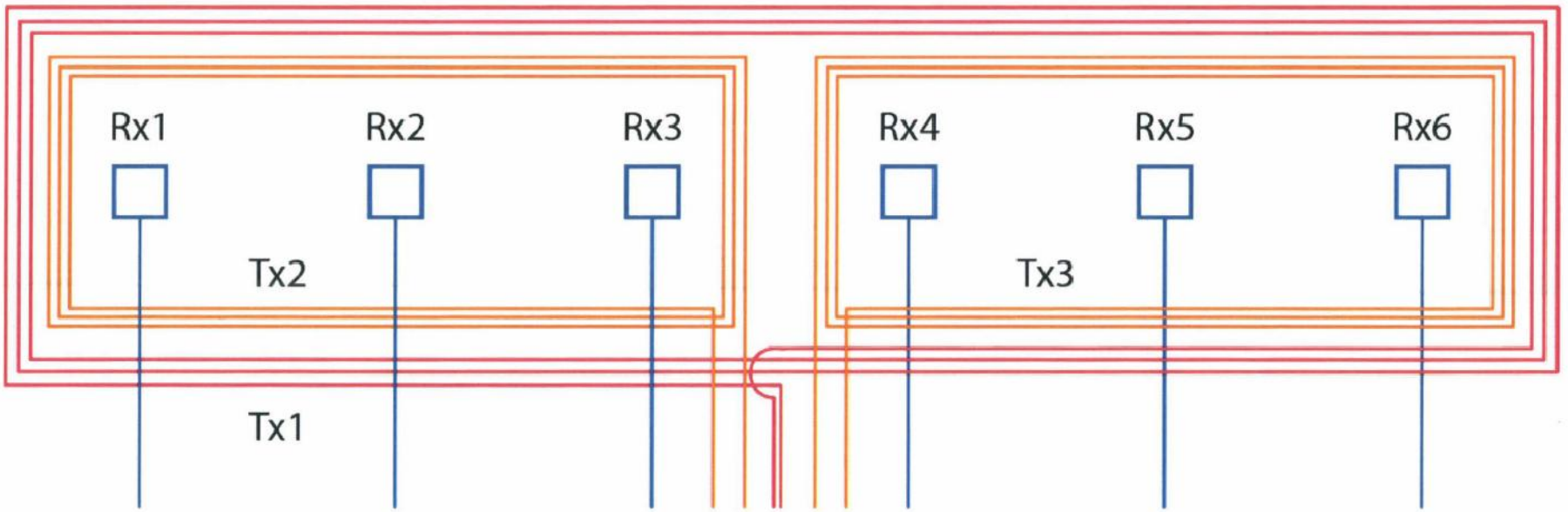
Photo: Leidos



18-L-0334/DOPSR/0118

mini Marine Towed Array Design

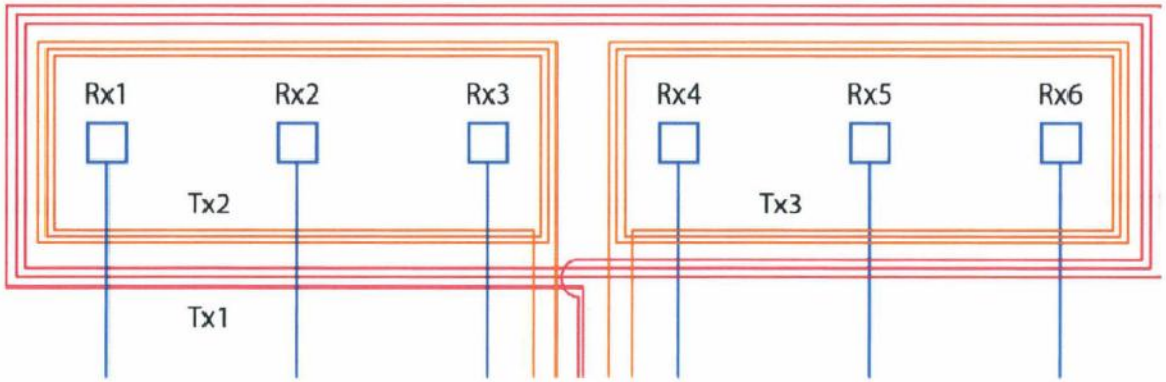
- ½ scale, 3 Tx loops
- 6 triaxial Rx cubes



18-L-0334/DOPSR/0119

Primary Field Excitation

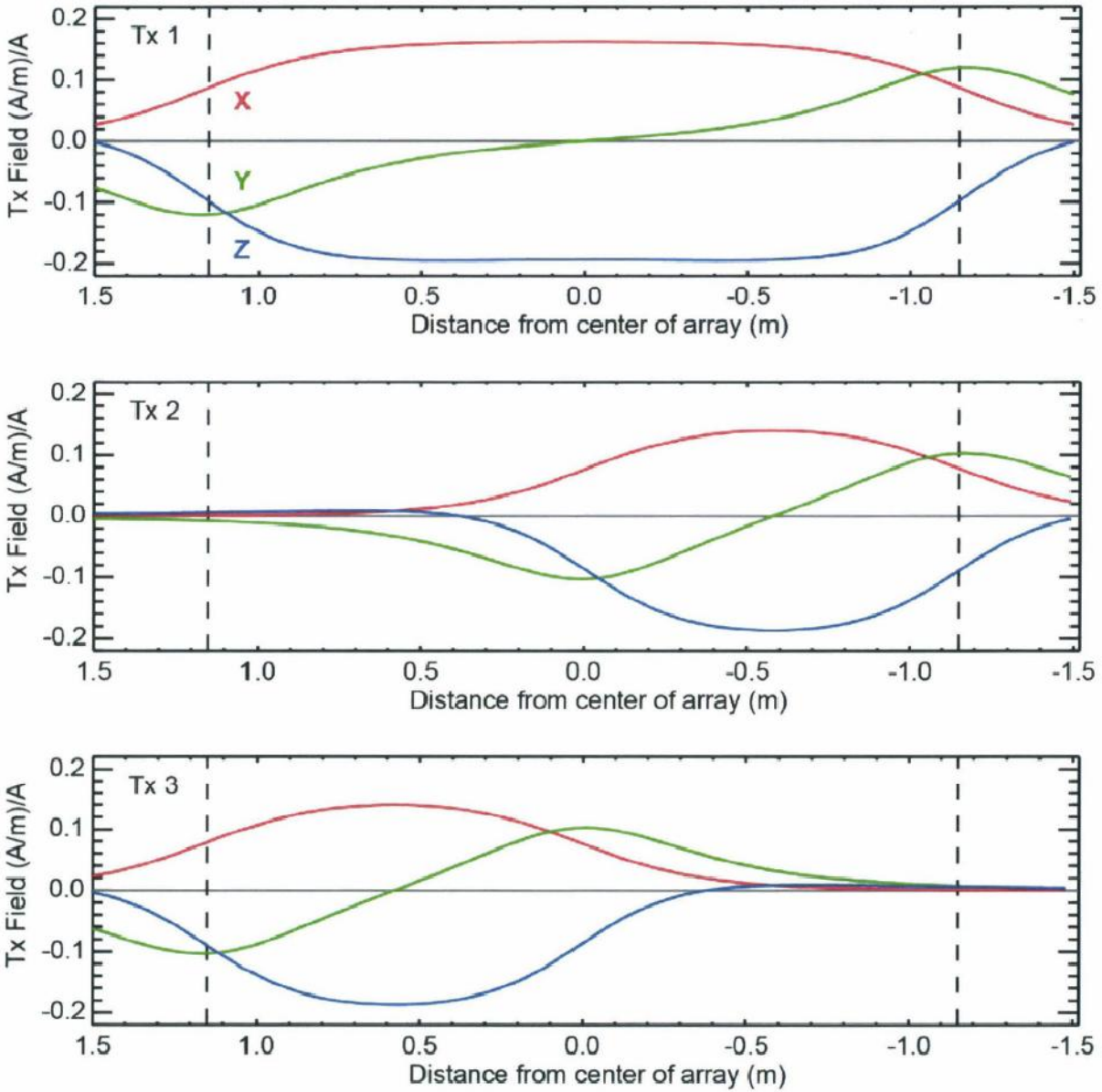
- Target must be excited by primary fields in three orthogonal directions
  - Y-axis excitation is weakest at the center of array for the outer loop
  - Paired inner loops give better Y-axis excitation over entire width of array



18-L-0334/DOPSR/0120

Primary Field Excitation

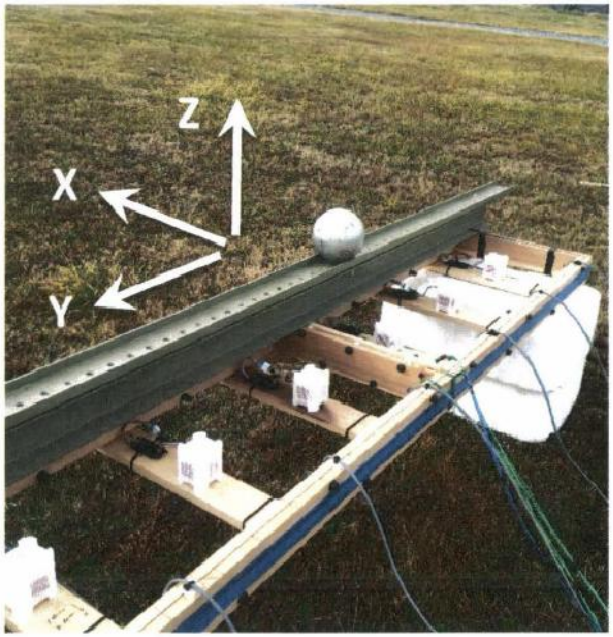
Primary field components 50 cm below array at its leading edge (x=25 cm)

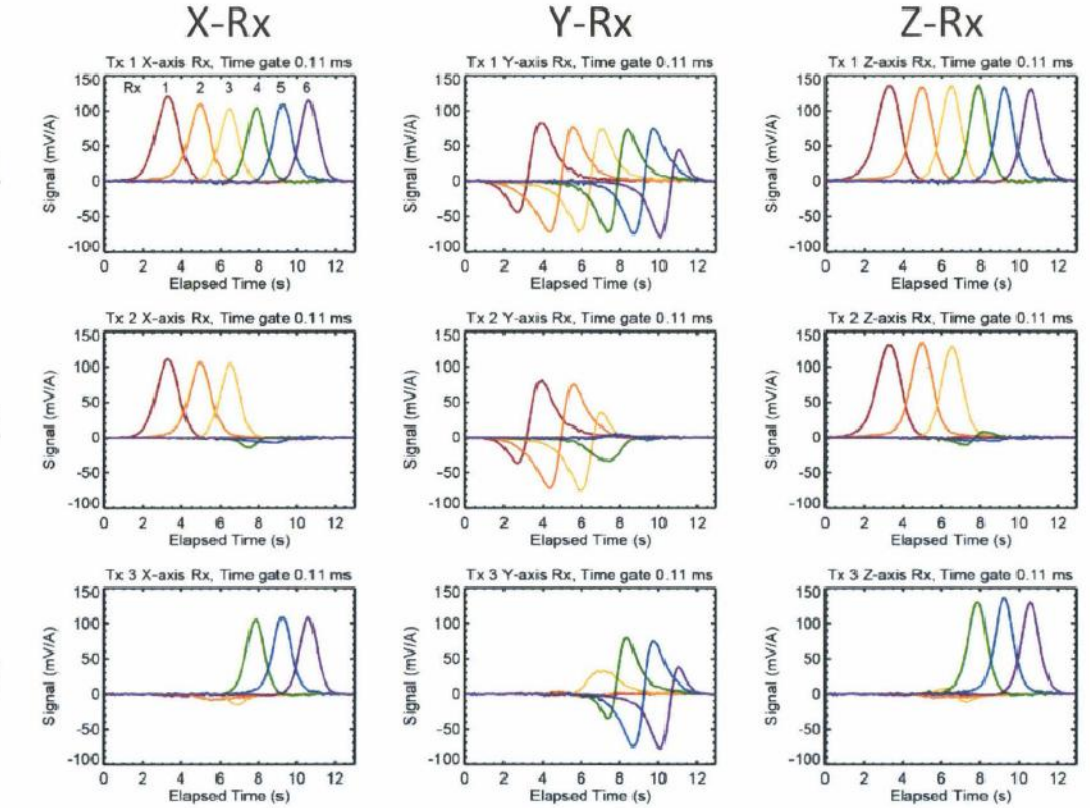


18-L-0334/DOPSR/0121

"Dynamic Data" Roll Test

- Strong X,Y,Z response as ball passes each cube



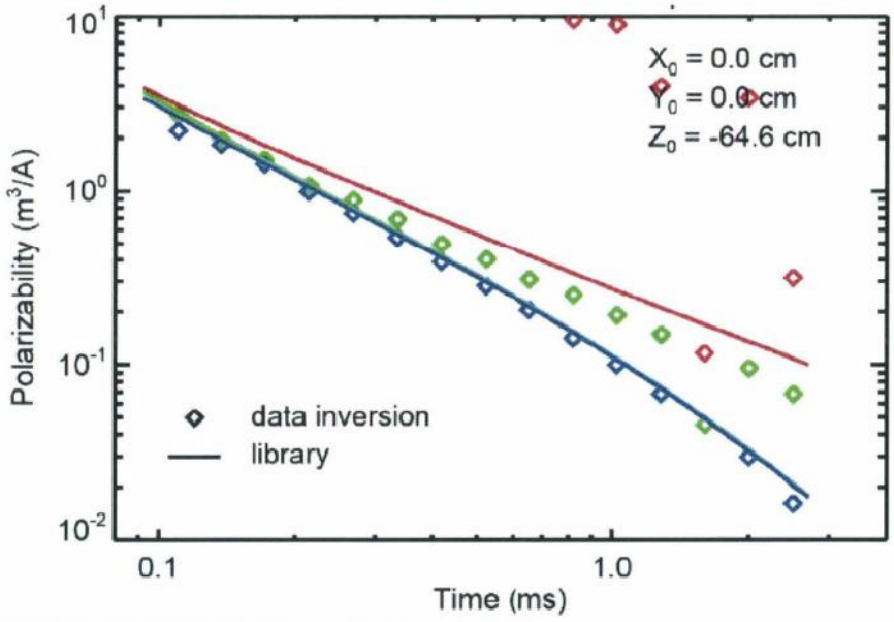


18-L-0334/DOPSR/0122

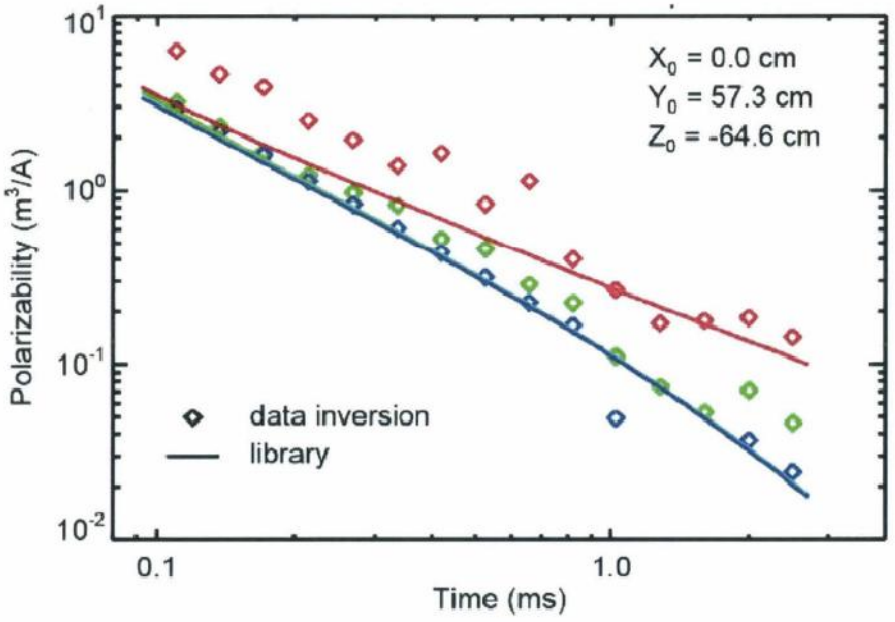
Classification: Outer Loop

- Polarizabilities not properly constrained
  - 57mm projectile

Target under center of array



Target under center of inner loop (Tx2)

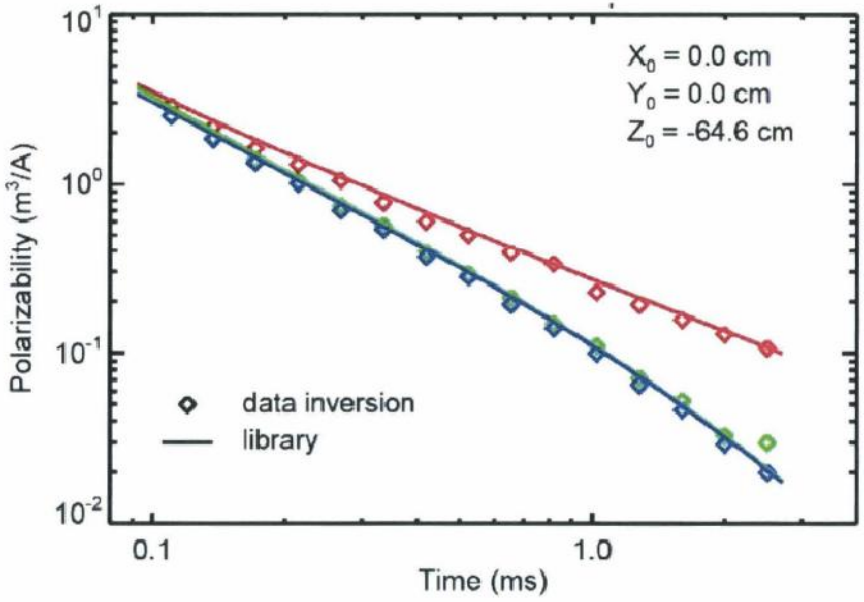


18-L-0334/DOPSR/0123

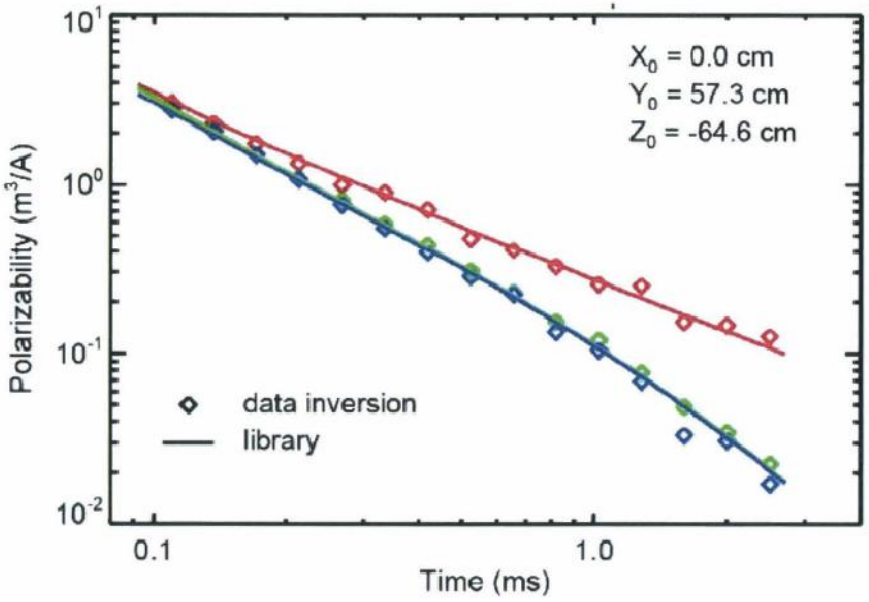
Classification: Inner Tx Pair

- Polarizabilities properly constrained
  - 57mm projectile

Target under center of array



Target under center of inner loop (Tx2)



18-L-0334/DOPSR/0124

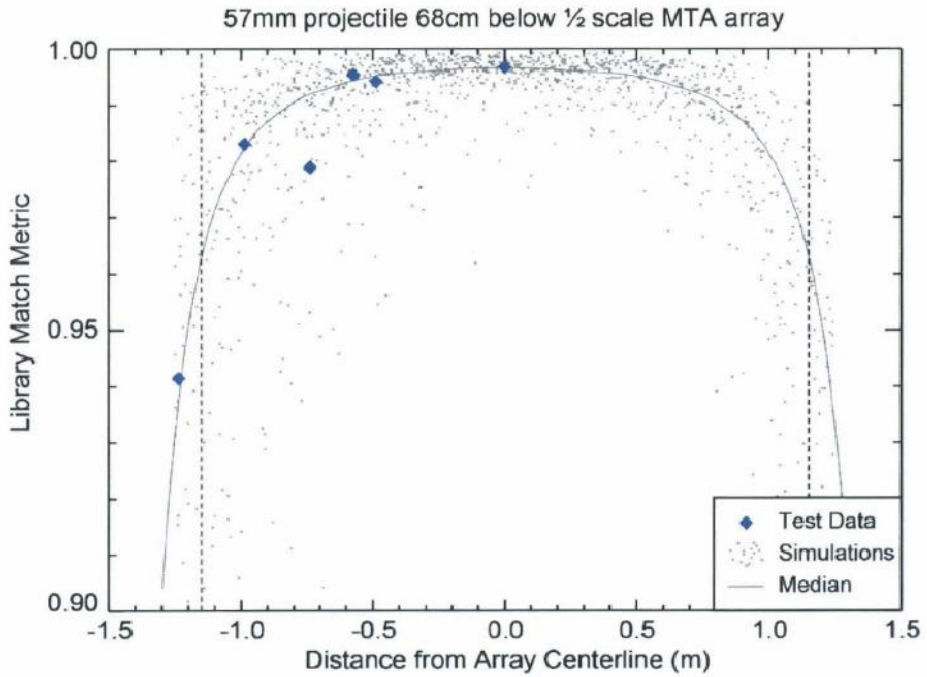
Classification Summary

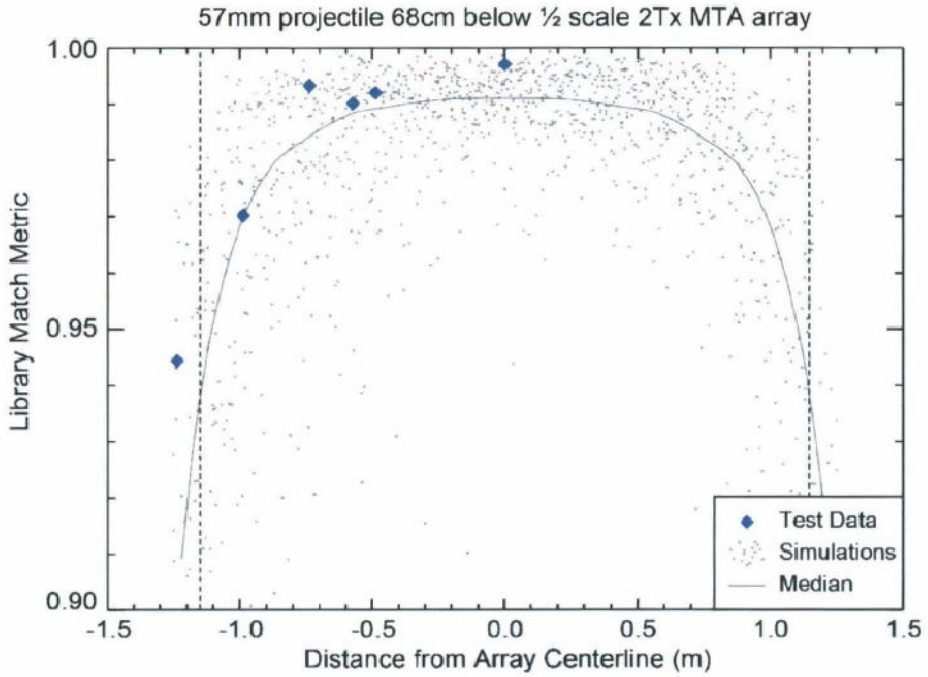
	Avg. Position Offset (cm)	Avg. Library Match (0 -> 1 = perfect)
Outer Loop Only		
Shallow, offset	2.4	0.7822
Deep, offset	4.3	0.8518
Inner Loops Only		
Shallow, offset	2.2	0.9997
Deep, offset	3.1	0.9780

18-L-0334/DOPSR/0125

Modeling Results

- Model developed from results to give predictive capability
  - How does the array behave?

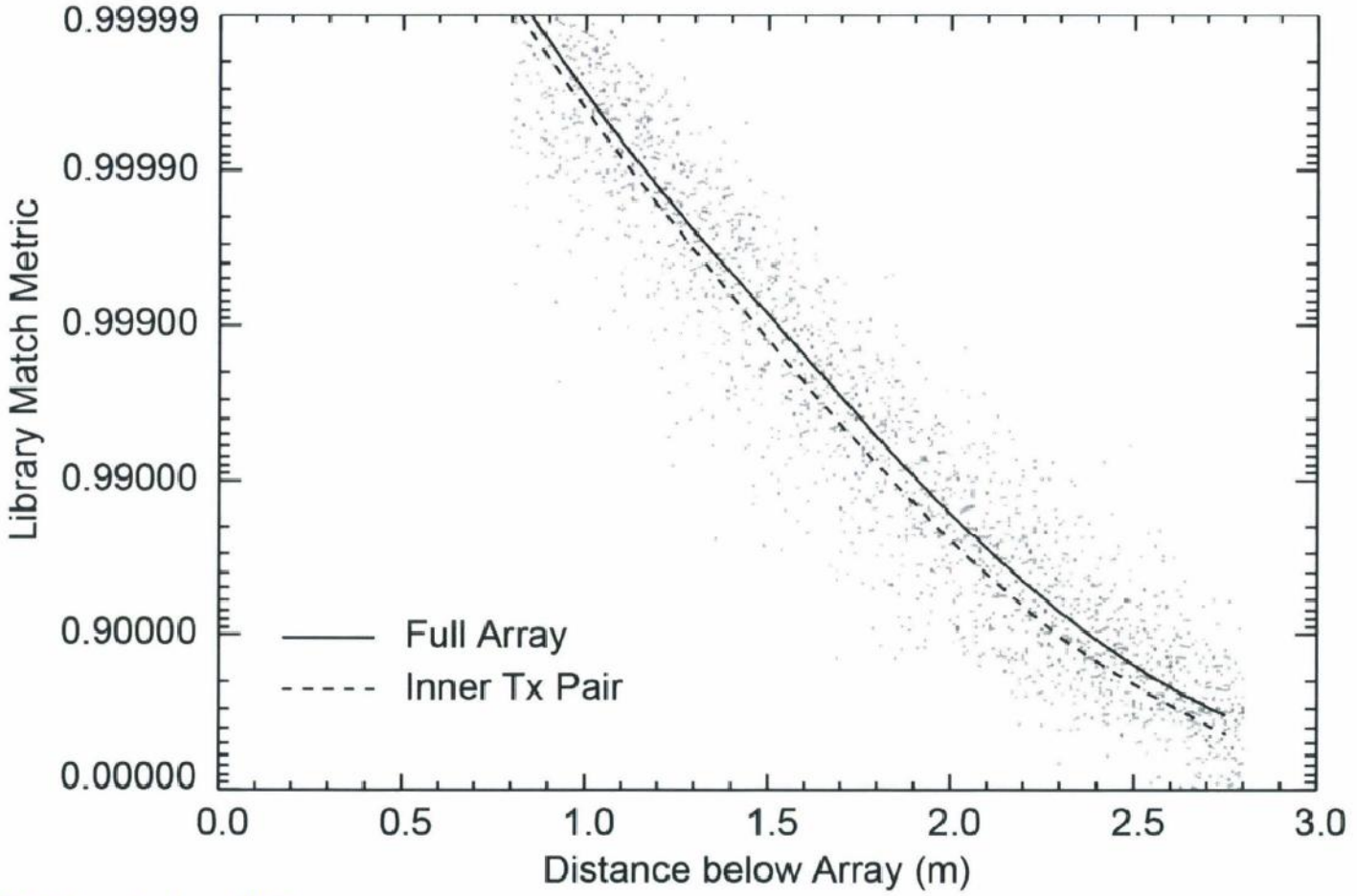




18-L-0334/DOPSR/0126

Model Performance of Full Array

Simulation results for the full array, 480 A-turns, 105mm Projectile



18-L-0334/DOPSR/0127

Conclusions

- New Marine Towed Array EMI array design successfully validated
  - The full array performs well over its entire width, as does the pair of inner coils by themselves
  - Classification performance models have been validated
- Half-scale model can robustly classify 57 mm projectiles at a range of 68 cm
  - Validated models predict that the array should be able to reliably classify large munitions (≥105 mm projectiles) at operationally useful depths
- Once functional, the Marine Towed Array will be a valuable tool in the DoD arsenal for detection and classification of underwater UXO

18-L-0334/DOPSR/0128

SERDP & ESTCP Webinar Series

For additional information, please visit:
https://www.serdp-estcp.org/Program-Areas/Munitions-Response/Underwater-Environments/MR-201610

Speaker Contact Information

daniel.steinhurst.ctr@nrl.navy.mil; 202-767-3556

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18-L-0334/DOPSR/0129

Kluzik, Donald E CIV WHS ESD (US)

17-S-2246

From: (b)(6) CIV DTSA TD (US)
Sent: Tuesday, August 15, 2017 3:05 PM
To: Kluzik, Donald E CIV WHS ESD (US)
Subject: RE: Security Review case 2246 (UNCLASSIFIED)
Signed By: (b)(6) @MAIL.MIL

Don,

These proposed publications provide detailed information concerning research and development activities having application to anti-surface warfare, anti-submarine warfare, and/or mine warfare. Many of these publications describe in very specific detail how one may architect and design a future system having verified sensor, sensor array, and/or system-level performance in the detection and classification of munitions / ordnance. This information may qualify as ITAR technical data that would be captured in ITAR / USML / Category XI(a)(9) - Military Electronics, Electronic Sensor Systems or Equipment for Non-Acoustic Anti-Submarine Warfare or Mine Warfare. Other developmental sections of the ITAR may be applicable as well depending on the specific effort. Distribution Statement D limiting distribution to the DoD and to DoD Contractors applies in this regard - work performed by DoD contractors on DoD contracted efforts.

v/r,
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(b)(6) @mail.smil.mil
(b)(6) @osdj.ic.gov

-----Original Message-----
From: Kluzik, Donald E CIV WHS ESD (US)
Sent: Tuesday, August 15, 2017 2:33 PM
To: (b)(6) CIV DTSA TD (US)
(b)(6) @mail.mil>
Subject: Security Review case 2246 (UNCLASSIFIED)
Importance: High

CLASSIFICATION: UNCLASSIFIED

Hello,

I am conducting the security review of case 17-S-2246, a 23-page presentation titled "Updating the Marine Towed Array for Advanced Geophysical Classification". You objected to public release, citing "Future systems applicable to ASW or mine warfare" and recommending Distribution D. I was wondering what reason to use in the distribution statement, since export control doesn't apply here. Thank you.

18-L-0334/DOPSR/0130

Don Kluzik
Defense Office of Prepublication and Security Review
2A534
703-614-4931

CLASSIFICATION: UNCLASSIFIED

18-L-0334/DOPSR/0131

Defense Office of Prepublication & Security Review

17-S-2246/0

Coordination Record

08/08/2017

SECURITY REVIEW

To: DTSA - DTSA ATTN: (b)(6)

Case Number: 17-S-2246/0

Type Of Document: SLIDES **# Pages:** 23 **Classsification:** Unclassified

Source: AT&L - Herbert Nelson **Event Date:** (b)(6)

Purpose: PUBLIC RELEASE **Requester:** Steinhurst, Dan

Subject: Updating the Marine Towed Array for Advanced Geophysical Classification

The attached material is forwarded for review in accordance with the following guidelines. Questions concerning this case should be directed to : DONALD KLUZIK, Room: 2A534, 7036144931, Email: donald.e.kluzik.civ@mail.mil, Unclassified Fax: 7036144956

Please send all comments to Ken Hanes 703-614-4927 kenneth.l.hanes.civ@mail.mil

Please advise if reviews required other than: DTSA
NRL

A reply is requested by: 08/14/2017

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To: Defense Office of Prepublication & Security Review, DOPSR, Room , 2A534, 1155 Defense Pentagon, Washington, DC 20301-1155

Review by this office in accordance with guidelines below, result in the following recommendation concerning clearance for publication.

Check One:

☐ **No Objection as Received.**

☐ **Recommended Changes.**

☐ **No Objection Subject to Amendments** made by this office (in black pencil). Amendments and rationale (security and policy) are annotated on page numbers listed below.

☒ **Objection.** Amendments to permit publication are impracticable. Reasons stated below.

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Defense Office of Prepublication & Security Review

17-S-2246/0

Coordination Record

08/08/2017

SECURITY REVIEW

To: NRL

Case Number: 17-S-2246/0

Type Of Document: SLIDES **# Pages:** 23 **Classsification:** Unclassified

Source: AT&L - Herbert Nelson **Event Date:**

Purpose: PUBLIC RELEASE **Requester:** Steinhurst, Dan

Subject: Updating the Marine Towed Array for Advanced Geophysical Classification

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Please advise if reviews required other than: DTSA
NRL

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1. DOCUMENT DESCRIPTION

a. TYPE	b. TITLE
Webinar Slides	Updating the Marine Towed Array for Advanced Geophysical Classification
c. PAGE COUNT	**d. SUBJECT AREA**
23	Strategic Environmental Research and Development Program (SERDP)

2. AUTHOR/SPEAKER

a. NAME *(Last, First, Middle Initial)*	b. RANK	c. TITLE
Steinhurst, Dan		Principal Investigator
d. OFFICE		**e. AGENCY**
		Nova Research, Inc.

3. PRESENTATION/PUBLICATION DATA *(Date, Place, Event)*

Posting on DTIC and SERDP web sites.

4. POINT OF CONTACT

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5. PRIOR COORDINATION

a. NAME *(Last, First, Middle Initial)*	b. OFFICE/AGENCY	c. TELEPHONE NO. *(Include Area Code)*
Nelson, Herbert	Acting Executive Director	571-372-6400
Leeson, Andrea	Deupty Director	571-372-6398

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NO SCRIPT PROVIDED

6. REMARKS

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Strategic Environmental Research and Development Program

b. CLEARANCE IS REQUESTED BY 20170814 *(YYYYMMDD).*

c. NAME *(Last, First, Middle Initial)*	d. TITLE
Nelson, Herbert	Acting Executive Director
e. OFFICE	**f. AGENCY**
OASD(EI&E)	AT&L
g. SIGNATURE	**h. DATE SIGNED *(YYYYMMDD)***
	20170807

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18-L-0334/DOPSR/0134 17-S-2246

SERDP & ESTCP Webinar Series

Updating the Marine Towed Array for Advanced Geophysical Classification

SLIDES ONLY
NO SCRIPT PROVIDED

Dr. Dan Steinhurst
Nova Research, Inc.

SERDP
DOD • EPA • DOE

ESTCP

18-L-0334/DOPSR/0135-16

Agenda

- Project motivation
- Marine Towed Array
- Sensors for unexploded ordnance (UXO) classification
- Array design and testing
- Modeling results
- Conclusions

18-L-0334/DOPSR/0136

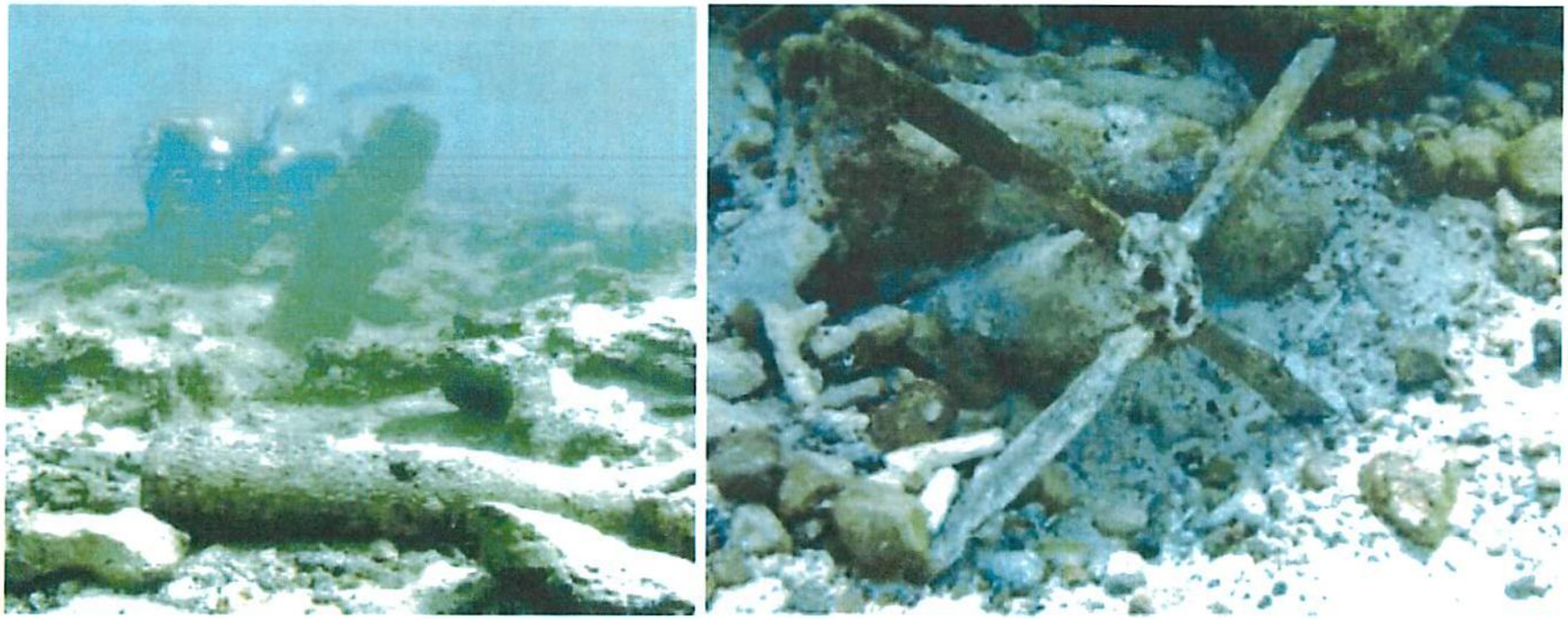
Project Motivation

- UXO
  - Large number of underwater sites
  - Present a significant human health risk
- Systematic detection and classification limited
  - Unfriendly survey conditions
  - Technology gaps, as compared to land surveys
- Acoustic systems
  - Significant standoff range
  - Limited capability against buried targets
  - Limited capability in shallow water (3-5 m)
- Adaptation of land-based UXO technology

18-L-0334/DOPSR/0137

UXO in the Underwater Environment

Photo: ESTCP MR-0324 - Bahia Salinas del Sur Final Report



18-L-0334/DOPSR/0138

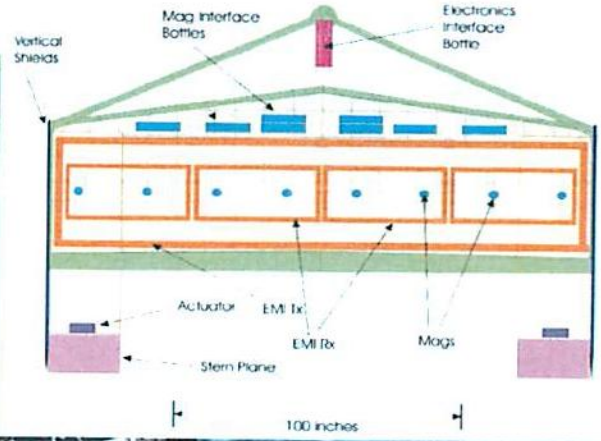
Marine Towed Array

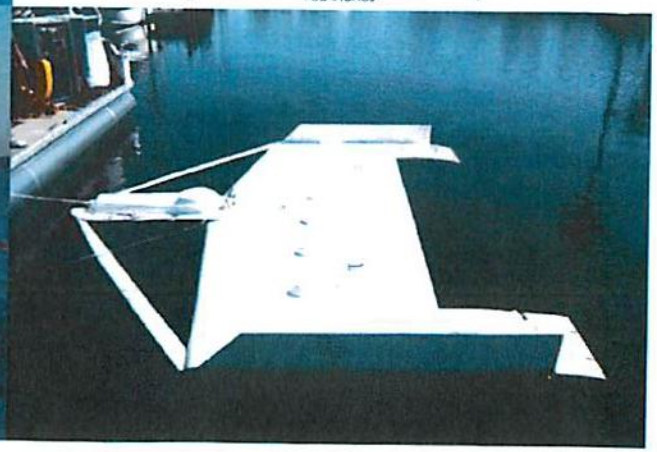
- Towed "Flying Wing" design
  - Development funded by SERDP/ESTCP
  - Dual-mode sensor array
    - Total-field Cesium-vapor magnetometers
    - Electromagnetic induction (EMI) sensor array
- Successfully demonstrated under a range of conditions
- 75 lane-km per day coverage with magnetometers

18-L-0334/DOPSR/0139

Marine Towed Array

Photos: ESTCP MR-0324 Reports





18-L-0334/DOPSR/0140

Sensors for UXO Classification

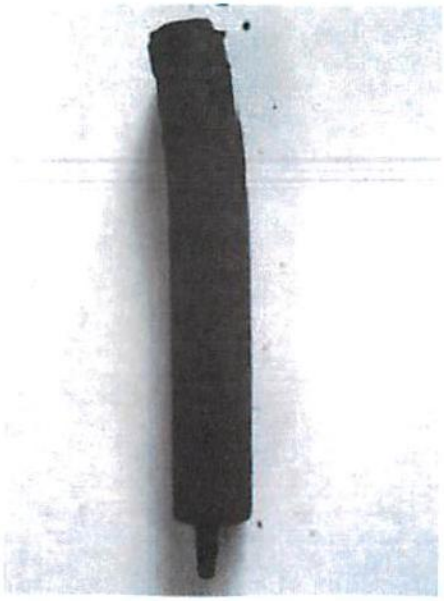
- Total-field magnetometry
  - Provides effective size and position
  - Little classification ability
- EMI
  - Advanced systems capable of determining
    - Position, depth, size, wall thickness, and shape
  - Robustly support UXO/clutter classification
  - Success demonstrated for land applications

18-L-0334/DOPSR/0141

Capability of Advanced Geophysical Classification

Photos: NRL, for ITRC GCMR-1 Fact Sheet

Munition



Suspected Munition

Munition Fragment

Debris

18-L-0334/DOPSR/0142

Advanced Geophysical Classification (AGC) Sensor Systems

Photos: ESTCP, URS, USACoE

18-L-0334/DOPSR/0143

EMI Array Upgrade

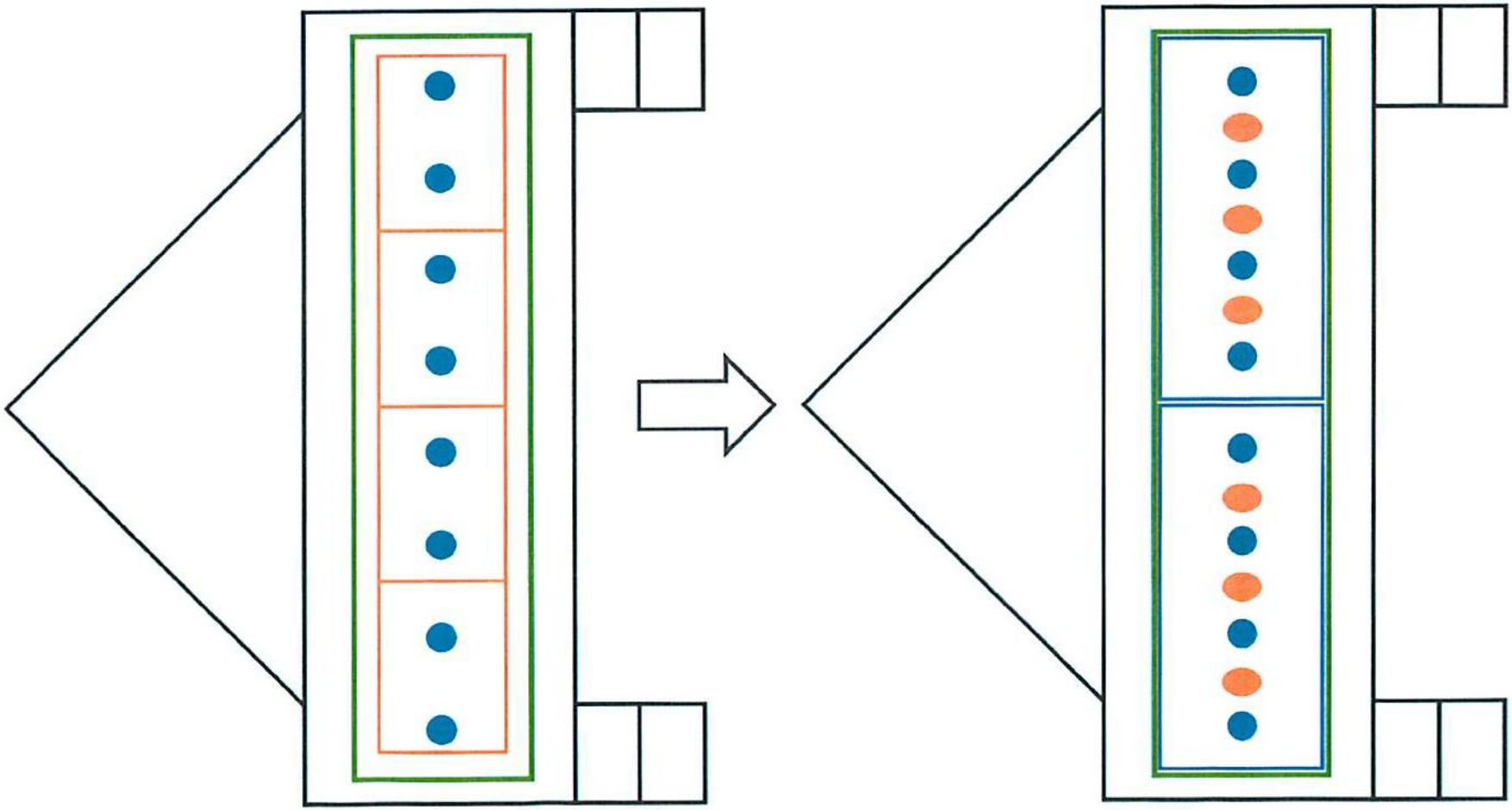
- Original array
  - Detection-only electronics
  - Low resolution
    - Four 0.5m x 1.0m receiver coils
  - Mechanical and electrical issues
- Updated design
  - AGC-level electronics
  - Multi-static data collection

18-L-0334/DOPSR/0144

EMI Array Schematic

Original Configuration

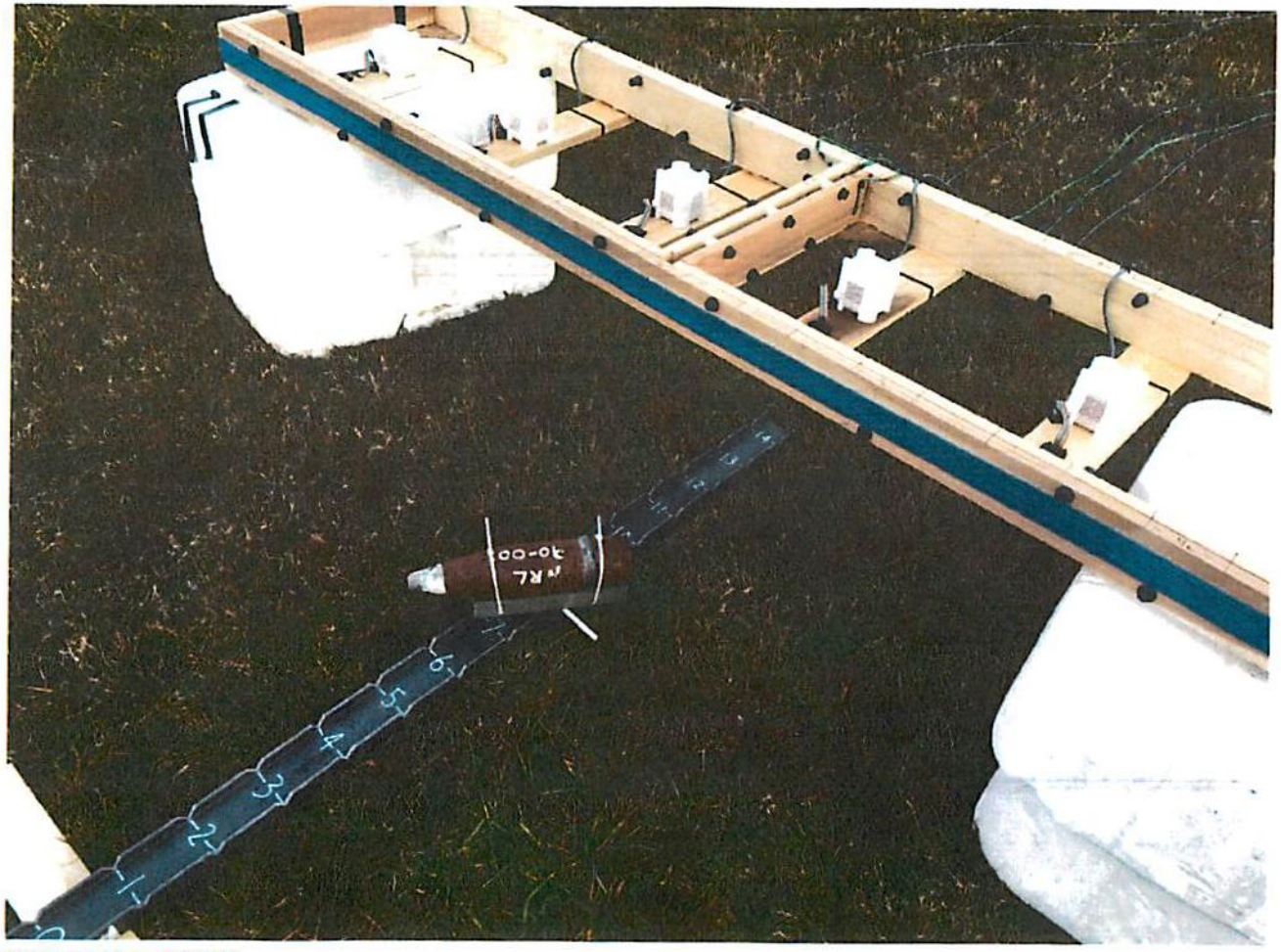
Proposed Configuration



18-L-0334/DOPSR/0145

Mini Marine Towed Array – Half-Scale Model

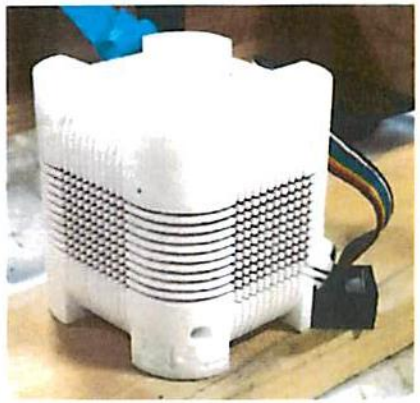
Photo: Leidos

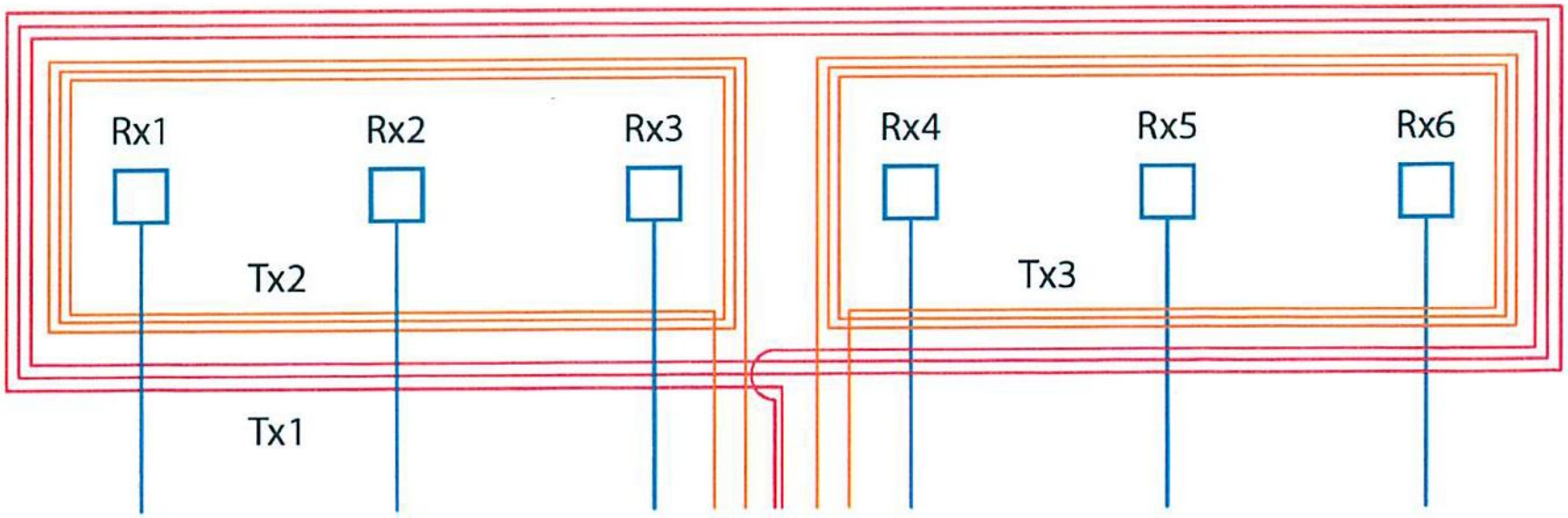


18-L-0334/DOPSR/0146

mini Marine Towed Array Design

- ½ scale, 3 Tx loops
- 6 triaxial Rx cubes

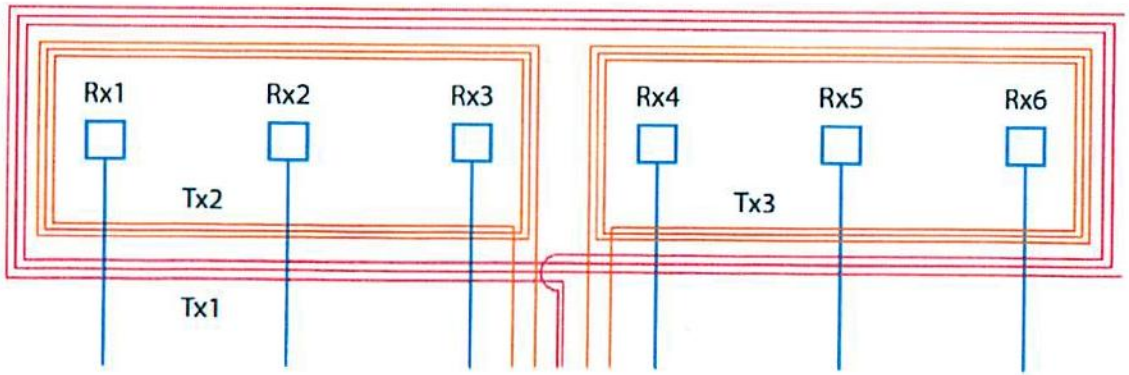




18-L-0334/DOPSR/0147

Primary Field Excitation

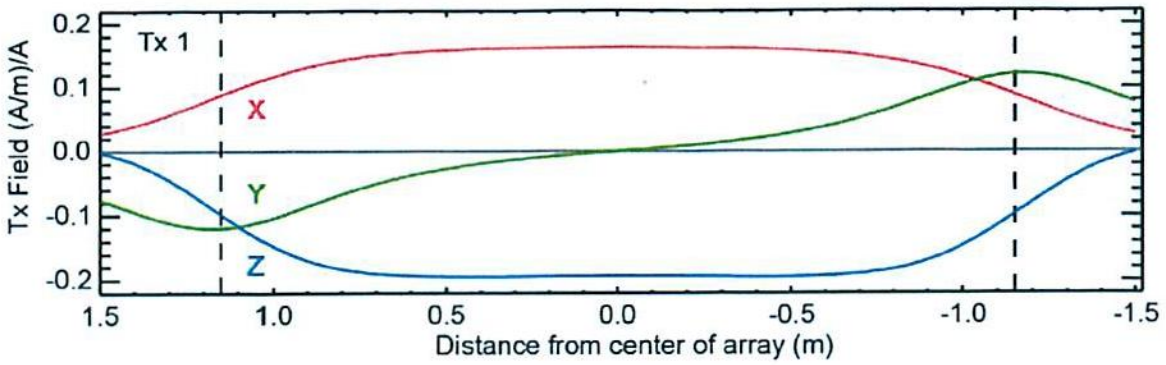
- Target must be excited by primary fields in three orthogonal directions
  - Y-axis excitation is weakest at the center of array for the outer loop
  - Paired inner loops give better Y-axis excitation over entire width of array

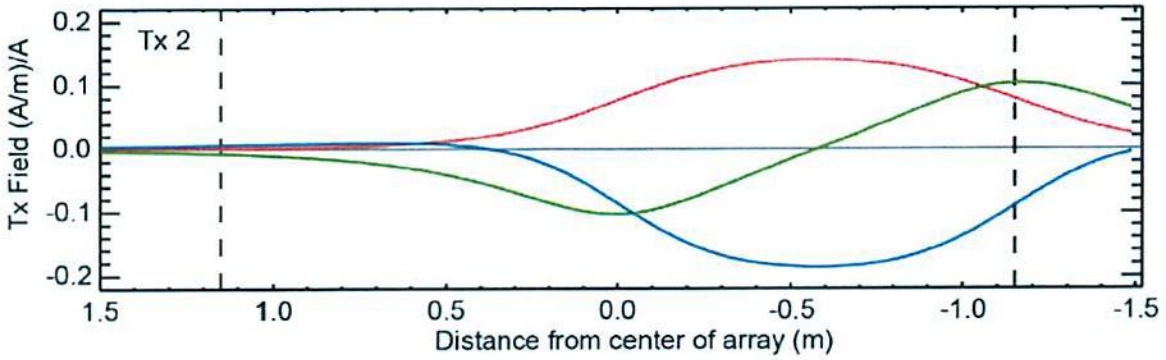


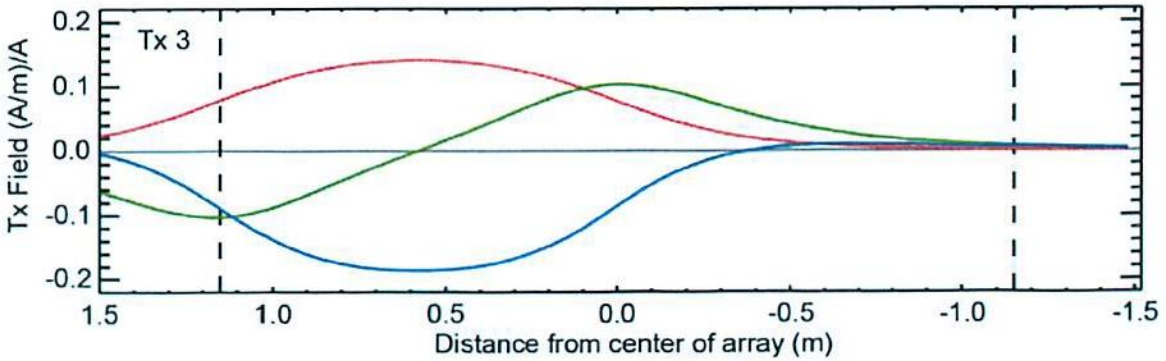
18-L-0334/DOPSR/0148

Primary Field Excitation

Primary field components 50 cm below array at its leading edge (x=25 cm)



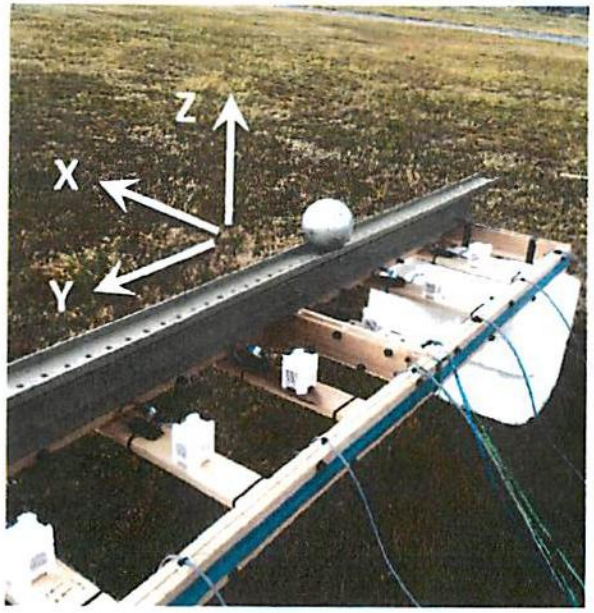




18-L-0334/DOPSR/0149

"Dynamic Data" Roll Test

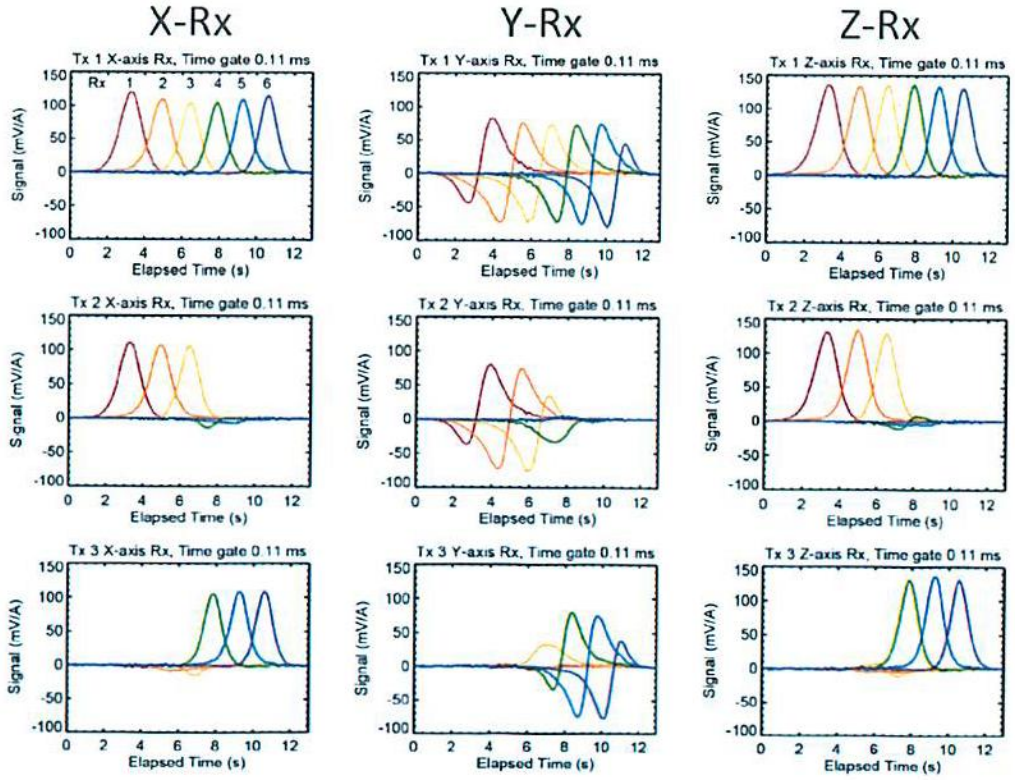
- Strong X,Y,Z response as ball passes each cube



Tx1

Tx2

Tx3

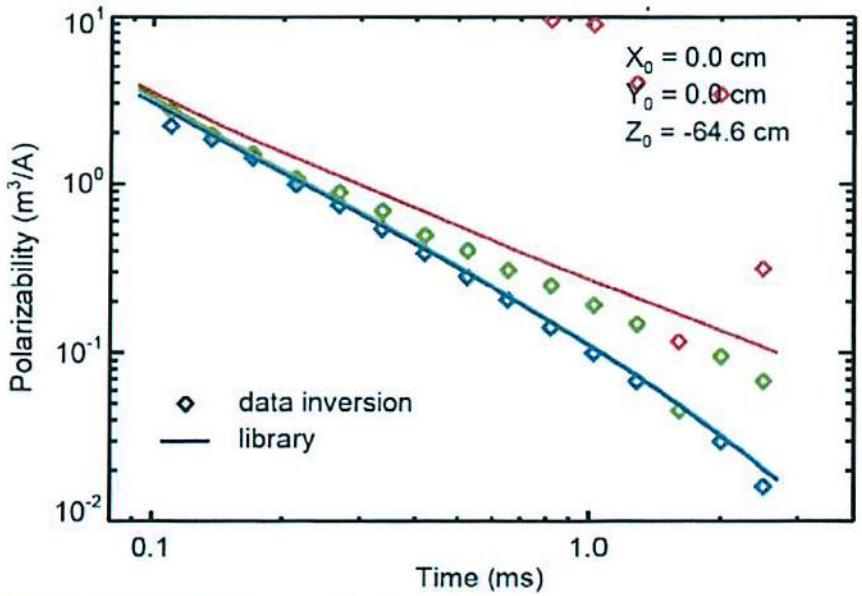


18-L-0334/DOPSR/0150

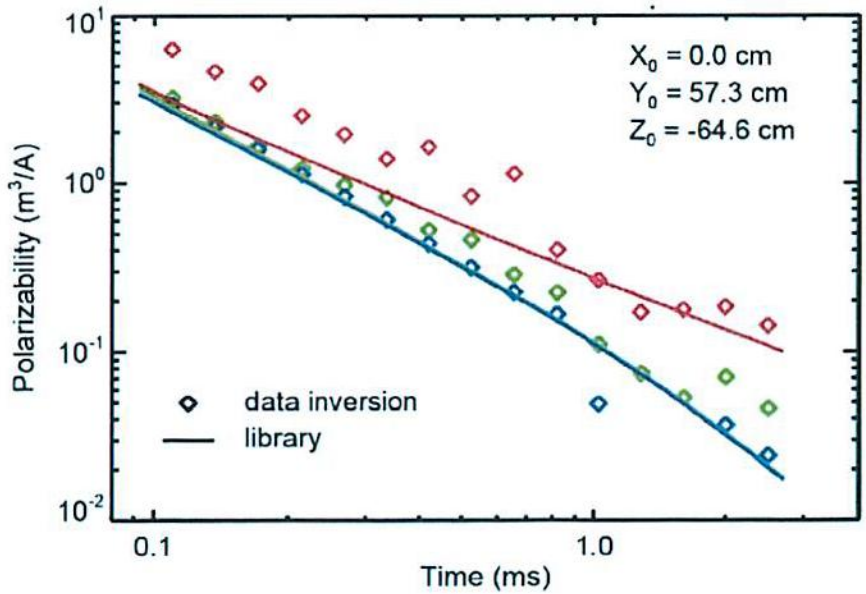
Classification: Outer Loop

- Polarizabilities not properly constrained
  - 57mm projectile

Target under center of array



Target under center of inner loop (Tx2)

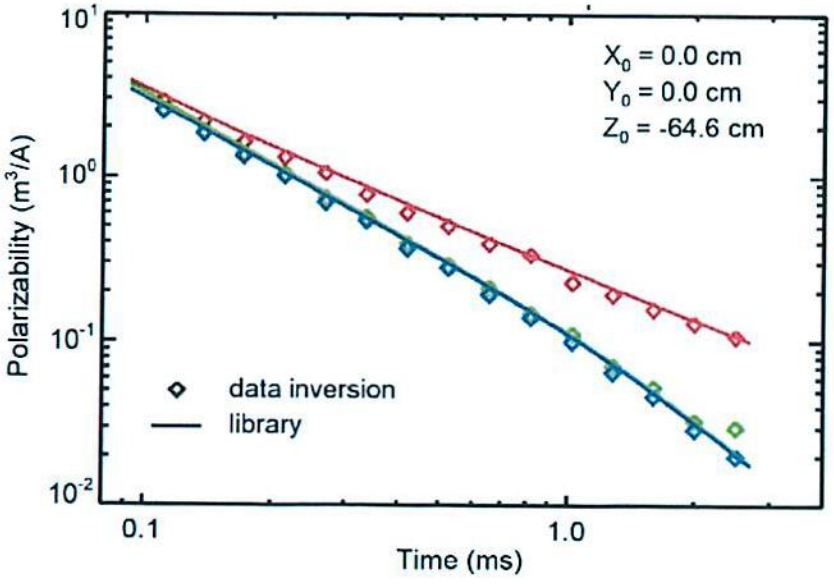


18-L-0334/DOPSR/0151

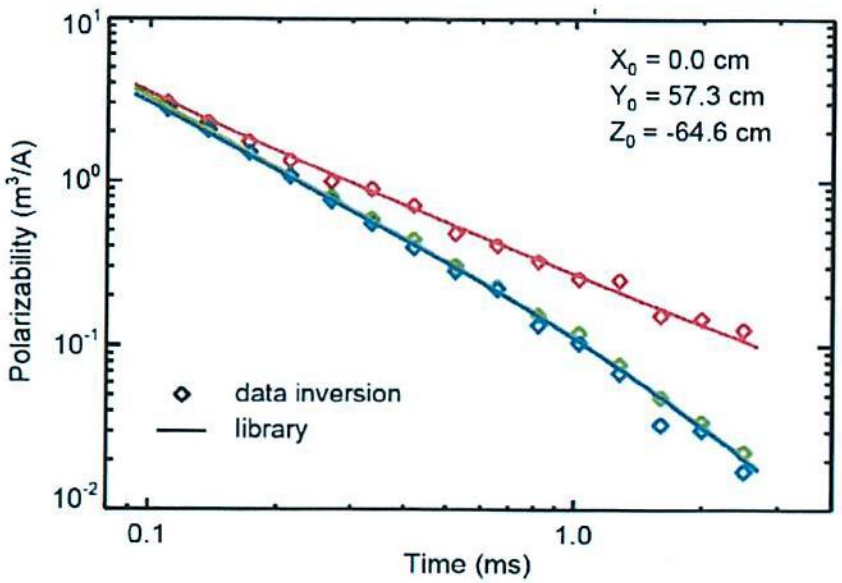
Classification: Inner Tx Pair

- Polarizabilities properly constrained
  - 57mm projectile

Target under center of array



Target under center of inner loop (Tx2)



18-L-0334/DOPSR/0152

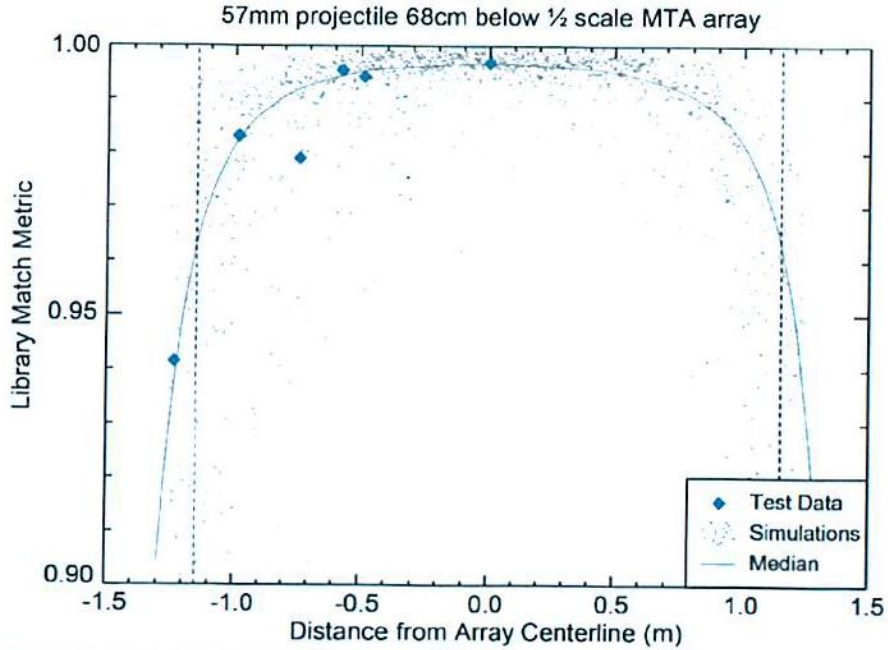
Classification Summary

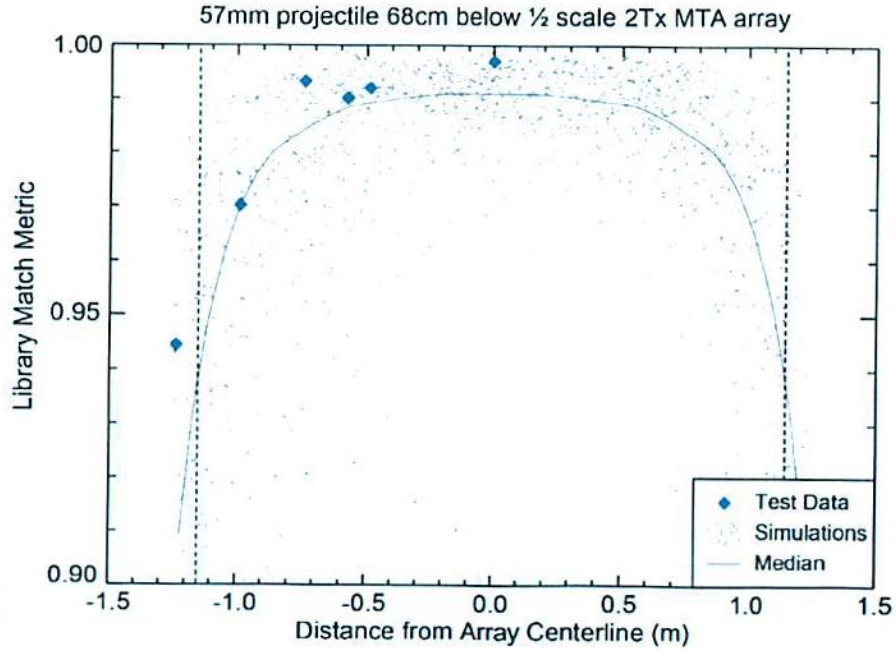
	Avg. Position Offset (cm)	Avg. Library Match (0 -> 1 = perfect)
Outer Loop Only		
Shallow, offset	2.4	0.7822
Deep, offset	4.3	0.8518
Inner Loops Only		
Shallow, offset	2.2	0.9997
Deep, offset	3.1	0.9780

18-L-0334/DOPSR/0153

Modeling Results

- Model developed from results to give predictive capability
  - How does the array behave?

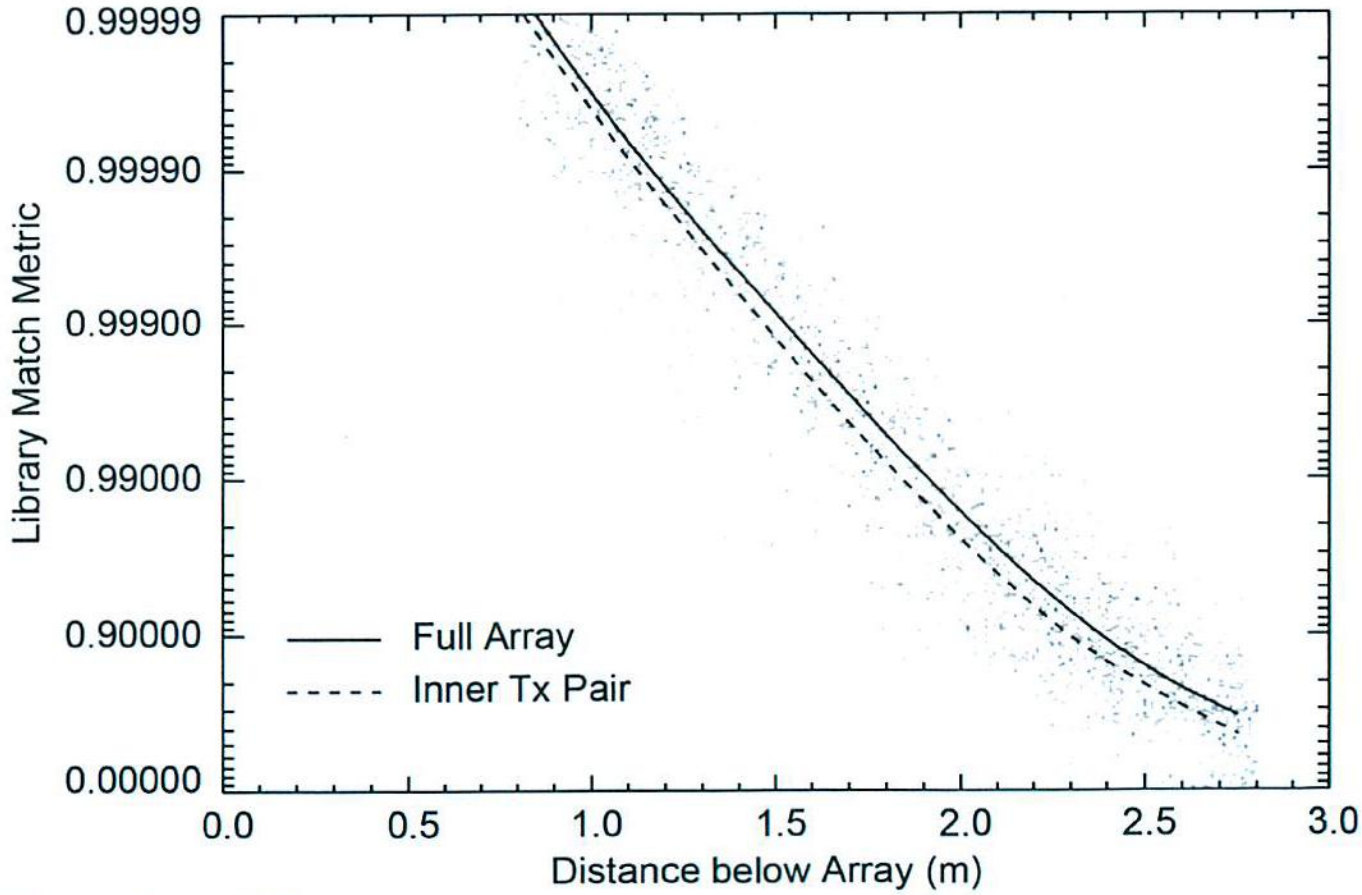




18-L-0334/DOPSR/0154

Model Performance of Full Array

Simulation results for the full array, 480 A-turns, 105mm Projectile



18-L-0334/DOPSR/0155

Conclusions

- New Marine Towed Array EMI array design successfully validated
  - The full array performs well over its entire width, as does the pair of inner coils by themselves
  - Classification performance models have been validated
- Half-scale model can robustly classify 57 mm projectiles at a range of 68 cm
  - Validated models predict that the array should be able to reliably classify large munitions (≥105 mm projectiles) at operationally useful depths
- Once functional, the Marine Towed Array will be a valuable tool in the DoD arsenal for detection and classification of underwater UXO

18-L-0334/DOPSR/0156

SERDP & ESTCP Webinar Series

For additional information, please visit:
https://www.serdp-estcp.org/Program-Areas/Munitions-Response/Underwater-Environments/MR-201610

Speaker Contact Information

daniel.steinhurst.ctr@nrl.navy.mil; 202-767-3556

SERDP
DOD • EPA • DOE

ESTCP

18-L-0334/DOPSR/0157

From: Kluzik, Donald E CIV WHS ESD (US)
To: (b)(6) @mail.mil"; Nelson, Herbert H CIV OSD OUSD ATL (US)
Subject: Security Review clearance 2246A1 (UNCLASSIFIED)
Date: Tuesday, October 31, 2017 9:49:00 AM
Attachments: EMAIL.pdf
2246A1.pdf

CLASSIFICATION: UNCLASSIFIED

Hello,

Attached is the clearance for the appeal for security review case 17-S-2246.

Don Kluzik
Defense Office of Prepublication and Security Review
2A534
703-614-4931

Comments - https://ice.disa mil/index.cfm?fsa=card&sp=139133&s=110&dep=*DoD

CLASSIFICATION: UNCLASSIFIED

From: Kluzik, Donald E CIV WHS ESD (US)
To: WHS Pentagon ESD Mailbox SECREV
Subject: FW: Appeal of Decision in Case 17-S-2246 (UNCLASSIFIED)
Date: Monday, October 16, 2017 2:43:06 PM

Case # 17-S-2246 Appeal # 1/1 (SG)

CLASSIFICATION: UNCLASSIFIED

Please open this as an appeal to 17-S-2246.

Don Kluzik
Defense Office of Prepublication and Security Review
2A534
703-614-4931

Comments - https://ice.disa mil/index.cfm?fsa=card&sp=139133&s=110&dep=*DoD

-----Original Message-----
From: Nelson, Herbert H CIV OSD OUSD ATL (US)
Sent: Monday, October 16, 2017 2:36 PM
To: Kluzik, Donald E CIV WHS ESD (US) <donald.e.kluzik.civ@mail mil>
Cc: (b)(6) CTR OSD OUSD ATL (US) <(b)(6) @mail.mil>
Subject: Appeal of Decision in Case 17-S-2246 (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

Mr. Kluzick - We recently received your office's decision in Case 17-S-2246 in which you directed that the subject presentation, "Updating the Marine Towed Array for Advanced Geophysical Classification," be marked with Distribution Statement D. I believe this presentation should be marked with Distribution Statement A for the reasons enumerated below.

The underlying Marine Towed Array technology (slides 5 & 6) has been described on our web site for many years. The project overview (https://www.serdp-estcp.org/Program-Areas/Munitions-Response/Munitions-Underwater/MR-200324/MR-200324) gives a brief overview of the technology and contains links to the seven available technical reports on the right side of the page.

Classification for Munitions Response using Magnetometer and Electromagnetic Induction Sensors (Slides 7 - 9) is also described on the web site (https://www.serdp-estcp.org/Featured-Initiatives/Munitions-Response-Initiatives/Classification-Applied-to-Munitions-Response) with Demonstrations at over 20 sites and dozens of reports available.

The system improvements planned and resulting test data (slides 10 - 20) are merely the application of the lessons learned from the Classification Demonstrations to the MTA. The system will only be useful for Munitions Response; the fall-off in sensitivity of the sensors with distance means that the array will have to be within a meter of two of the expected target to receive any signal. This system will have no applicability as a remote monitor or wide-area detector.

Before contacting you, I checked my opinion with (b)(6) @navy mil, 703-696-(b)(6) and (b)(6) @navy mil, 703-696-(b)(6) of ONR's Mine Countermeasures Program and they both confirmed my thoughts.

Please ask your reviewers to consider the above inputs as they review their determination.

Herb

****

Herb Nelson
Director and Program Manager for Munitions
SERDP & ESTCP
571-372-6400 (V)
(b)(6) (C)

CLASSIFICATION: UNCLASSIFIED
CLASSIFICATION: UNCLASSIFIED

Defense Office of Prepublication & Security Review

17-S-2246/1

Coordination Record

10/16/2017

SECURITY REVIEW

To: DTSA - DTSA ATTN (b)(6)

Case Number: 17-S-2246/1

Type Of Document: PUBLICATION **# Pages:** 23 **Classsification:** Unclassified

Source: AT&L - Herbert Nelson **Event Date:**

Purpose: PUBLIC RELEASE **Requester:**

Subject: Updating the Marine Towed Array for Advanced Geophysical Classification

(b)(6) [redacted]

The attached material is forwarded for review in accordance with the following guidelines. Questions concerning this case should be directed to : DONALD KLUZIK, Room: 2A534, 7036144931, Email: donald.e.kluzik.civ@mail.mil, Unclassified Fax: 7036144956.

Please advise if reviews required other than: DTSA

A reply is requested by: 10/30/2017

COORDINATION OFFICE ACTION

To: Defense Office of Prepublication & Security Review, DOPSR, Room , 2A534, 1155 Defense Pentagon, Washington, DC 20301-1155

Review by this office in accordance with guidelines below, result in the following recommendation concerning clearance for publication.

Check One:

→ - STAFF DoN - ONR/ONI/PMR-5/NIPO
- ITAR, USM(, CAT. XI(9)(7) - DEVELOPMENTAL SYSTEM FUNDED BY DoD; XI(9)(1)(iii)

☐ **No Objection as Received.**

☐ **Recommended Changes.**

☐ **No Objection Subject to Amendments** made by this office (in black pencil). Amendments and rationale (security and policy) are annotated on page numbers listed below.

☒ **Objection.** Amendments to permit publication are impracticable. Reasons stated below.

(Continue on reverse side if necessary)

DIST. STATEMENT D : THE AUTHOR'S OWN STATEMENTS DISAGREE W/ SERDP PROVIDED RATIONALE ON SLIDE 22 - CONCLUSIONS.

(b)(6) [redacted]

date 18 OCT 17

10/19

(b)(6) [redacted]

Instructions: It is the policy of the Department of Defense to authorize and encourage the public rele... Department of Defense consistent with security requirements, and other exemptions to disclosure under the Freedom of Information Act.

Security: Reviewing agencies should identify information known to be classified within the meaning of Executive Order 13526 (DoD Regulation 5200.1R) or information which in the judgement of the reviewing agency warrants classification. In the latter case, it is requested that reasons for this judgement be given and recommendations made for appropriate classification.

Policy: Material originated with the Department of Defense for public release should, in addition, be reviewed for conflict with established policies and programs of the Department of Defense or those of the national government. If change is necessary, reviewing agencies are requested to recommend acceptable substitute language where practicable, or specify needed change in sufficient detail to permit acceptable revision.

Editorial: Editorial review is not the responsibility of the Defense Office of Prepublication and Security Review and reviewing agencies should not make editorial corrections. However, obvious errors of fact should be indicated.

Defense Office of Prepublication & Security Review

Case Number: 17-S-2246/1 **Source:** AT&L - Herbert Nelson

Subject: Updating the Marine Towed Array for Advanced Geophysical Classification

Purpose: PUBLIC RELEASE **Event Date:** **Pages:** 23

Requester: **Document Type:** PUBLICATION

Date Received: 10/16/2017 **Classification:** Unclassified **Typist:** DKLUZIK

Suspense Date: 11/28/2017 **Date Completed:**

Reviewer's Worksheet: **Action Officer:** DKLUZIK

Agency Name	Routed Date	Due Date	Action	Remarks
DTSA	10/16/2017	10/30/2017	OBJ	23-OCT-2017
NAVY DUSN(P)	10/24/2017	11/07/2017	NO OBJ	30-OCT-2017
OASD EI&E	10/16/2017	10/30/2017	NO OBJ	Requestor, 31-OCT-2017

Notes:

Comments: (continue on reverse side if necessary)

OSR Action

Recommended Action

- ☐ **Cleared**
- ☐ **Cleared as Amended**
- ☐ **Not Cleared**
- ☐ **See Memo Attached**

Initials/Date _____

Final Action

- ☒ **Cleared**
- ☐ **Cleared as Amended**
- ☐ **Not Cleared**
- ☐ **See Memo Attached**

Initials/Date DK 31-OCT-2017

Case should be indexed under the following keywords: _____

18-L-0334/DOPSR/0162

Memorandum for the Record

17-S-2246/1

31 October 2017

Following DOPSR's initial denial of public release, submitter met with us and explained that SME's from Navy's ONR Mine Countermeasures Program had reviewed the document and had no objection to public release. Case was formally re-submitted as appeal and routed by DOPSR to DTSA and Navy. DTSA again objected to public release and recommended review by multiple Navy offices. Navy SME's responded with no objection to public release.

DOPSR will follow recommendations of SME's and clear for public release.

Don Kluzik

18-L-0334/DOPSR/0163

From: (b)(6) CIV ONR
To: Kluzik, Donald E CIV WHS ESD (US); (b)(6) CIV USN DUSN POLICY (US); (b)(6) CIV USN DON AA WASHINGTON DC (US); (b)(6) CIV ONR, 322
Subject: RE: Appeal review request 2246 (UNCLASSIFIED)
Date: Monday, October 30, 2017 4:29:46 PM

Don,

Per the US Navy's SCG for Mine Countermeasures, there's nothing in this brief to preclude public release. I concur with Distro A.

v/r, (b)(6)

(b)(6)
Program Officer & Team Lead

Office of Naval Research
Mine Warfare & Ocean Engineering Programs
Code 32, Suite 1092
875 N. Randolph St
Arlington, VA 22203, USA
Voice: 703-696-(b)(6)
Cell: (b)(6)
Fax: 703-696-2007
(b)(6) @navy mil
(b)(6) @navy.smil.mil
www.onr navy mil >> Code 32 >> Ocean Engineering & Marine Systems

-----Original Message-----
From: Kluzik, Donald E CIV WHS ESD (US) [mailto:donald.e kluzik.civ@mail.mil]
Sent: Tuesday, October 24, 2017 11:58 AM
To: (b)(6) CIV DUSN (Policy), Security; (b)(6) DUSN (P), Security; (b)(6) CIV ONR; (b)(6) CIV ONR, 322
Subject: Appeal review request 2246 (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

Hello,

I am requesting that a security review be conducted on the attached appeal for case 17-S-2246. Submitter requests reviews by ONR, ONI, PMR-5, and NIPO. Thank you.

Don Kluzik
Defense Office of Prepublication and Security Review
2A534
703-614-4931

Comments - https://ice.disa mil/index.cfm?fsa=card&sp=139133&s=110&dep=*DoD